RADIO and ELECTRONICS

ELECTRICITY — COMMUNICATIONS — SERVICE — SOUND

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DECEMBER, 1st, 1951 VOL. 6, NO. 10 1/10

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OUR COVER

This month's cover gives a comprehensive view of the Holme Moss TV transmitting tower and aerial, part of which was featured on last month's cover. Photo by courtesy of Messrs. British Insulated Callender's Construction Co., Ltd., England.

●

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Greetings for Christmas and the New Year

The Editor and Staff of *Radio and Electronics* take this opportunity of wishing all our friends, whether readers, advertisers, or other business associates, the very best of Christmases, and the most prosperous of New Years. While it is not our habit to launch forth into prophesy, we hope that the coming year may see the beginnings of wide and far-reaching developments in New Zealand's electronics industry, and that the industry will continue to flourish greatly.

From New Zealand Radio and Television Manufacturers' Federation:

"May I take this opportunity of expressing once again through the courtesy of *Radio and Electronics* best wishes for a happy Christmas and a prosperous New Year to all concerned in the radio industry. The year now drawing to its close has reached a new peak in radio licences in the Dominion and will, I believe, show a record level of radio receiver sales. Let us all hope that 1952 will maintain this trend and that the shadow of conflict, which at present causes us all so much anxiety, will recede once and for ever."

T. J. F. SPENCER, *President.*

From New Zealand Radio Traders' Federation:

"To members throughout New Zealand of the Radio Traders' Federation and to radio traders and those trading as radio servicemen, it is again my privilege as President of the Association to convey to you the season's greetings, and I trust increased and prosperous business for 1952. The past year has been beset with many difficulties, the settlement of which has had the undivided attention of your executive. To those who are not members, may I say co-operation means success. Join up now with your local Association and thus assure for all radio traders an excellent 1952."

J. FAIRCLOUGH, *President.*

From New Zealand Electronics Institute:

"Once again the Christmas festive season approaches and it is my pleasant duty to convey to all members of the Institute the sincere good wishes of the Council and myself. Many new members have been enrolled this year and it is gratifying to see the steady progress being made by the Institute and to observe the unbounded enthusiasm of its members.

"I would also like to record my appreciation of the loyal support of the Council and other officers and members of the Institute during the past year, and which support has enabled my duties to be very pleasant ones.

"A merry Christmas and a happy New Year to you all."

W. L. HARRISON, *President.*

We have received the following message from the President of the New Zealand Radio Traders' Federation:

"To all associated with the production of *Radio and Electronics,* I wish at this period of the year to say thank you for the wonderful co-operation and assistance we have received during 1951, and to say a merry Christmas and a happy New Year."

J. FAIRCLOUGH, *President.*

We are deeply grateful to Mr. Fairclough and the Radio Traders' Federation for this message, valuing as we do the help and co-operation of the radio industry. We, on our part, reciprocate the good wishes, and would like to say that whatever we can do, through *Radio and Electronics* and otherwise, to promote the interests of the radio trade and industry, will be gladly done.

W. D. FOSTER, *Managing and Technical Director.*

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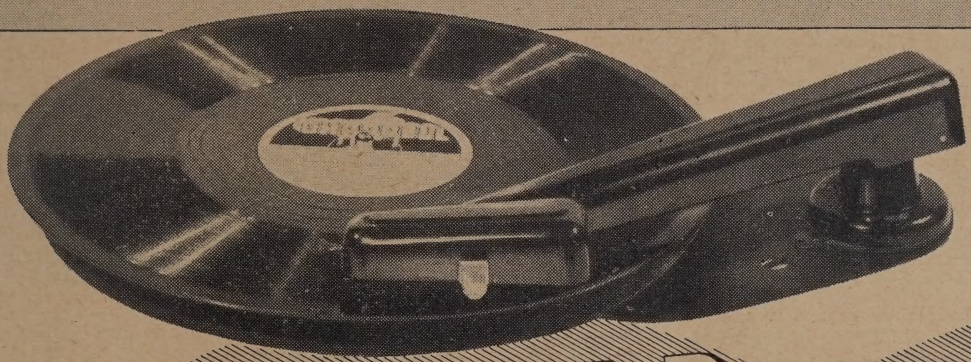

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A Practical Way of Building Speaker Dividing Networks

A new magnetic material for audio frequencies has made it a simple matter for anyone to wind inductors with known values of inductance. It is thus possible to build dividing networks and filters without facilities for accurately measuring inductance.

INTRODUCTION

Several times in these pages we have made reference to the desirable attributes of speaker systems in which one speaker is used for the bass and lower-middle frequencies, while the other is used for the high and upper-middle frequency range. Indeed, the theoretical advantages of this scheme are well known to most audio enthusiasts, who are frequently deterred from doing something about it only by the practical difficulties involved in actually building the dividing network that must be used with the two speakers. This is unfortunate, because it is our contention that even if two low-priced speakers are used, the result must be a reduction of distortion, which is always acceptable, however obtained!

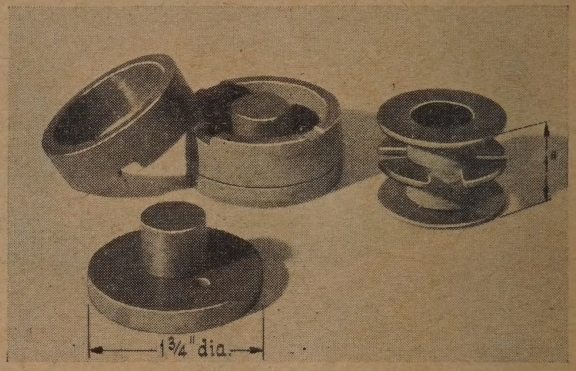
However, a new magnetic material which has recently been developed, and which is now on the market in a variety of forms, seems to have solved the most difficult part of the problem at one stroke. It should now be quite possible for anyone who possesses the means of measuring either audio frequencies, or capacity, or both, to build his own dividing networks. Hitherto, this was almost impossible unless one could measure inductance, with the result that most of us lived entirely without benefit of dividing networks and dual-speaker installations!

Before going on to say more about how this desirable state of affairs comes about, it would perhaps be as well to state what the problem is, and to recapitulate the advantages to be gained.

ADVANTAGES OF DUAL SPEAKER SYSTEMS

There are two main reasons why the single speaker has very largely been superseded in commercial installations in which quality of reproduction is important. The first, and perhaps the most important, is that by dividing a given amount of power between two or more speakers, instead of feeding it to a single one, the distortion produced by the speaker cone itself is very materially reduced. In this connection we mean the harmonic and sub-harmonic distortion that occurs when the cone is driven to large amplitudes of movement, together with the intermodulation distortion generated at the same time, in the form of sum and difference frequencies between the various frequency components that are being handled. It is quite logical, and probably true in practice, to assume that even if all the speakers are simply fed in series or parallel so that the power only is divided between them, distortion due to the speaker system will be much less than if the same power was fed to only one of the same kind. But there are certain things which make this simple solution not so attractive. First and foremost, is the difficulty of properly baffling a number of speakers, all fed with the complete range of audio frequencies. Providing a baffle that works satisfactorily for one speaker presents enough of a problem rather to put one off the idea of finding out how suitably to baffle a number of units, which must all be as close together as possible, and which cannot be allowed to spread quite all over the living room! Seriously, though, not very much work seems to have been done on the problem, so that one's chances of attaining a satisfactory result do not appear very bright.

The next step forward is to divide not only the power between two speakers, but the frequency spectrum also. In this way the above-mentioned difficulty is overcome, since, as in the single-speaker case, only one speaker has to be provided with a low-frequency baffle. The possibilities for reducing the distortion are further widened, since now, the low and high frequencies are fed to entirely separate speakers, so that intermodulation between



A "Ferroxcube" pot-type core, which makes the construction of inductors for dividing networks delightfully simple and easy. The component parts of one complete core are shown, together with the bobbin provided as a coil-former.

them cannot be generated at all. (Intermodulation between high and low notes is the most obvious and distressing type of distortion for the ear to cope with.)

As a direct result of the reduction of distortion, it becomes (a) possible, and (b) desirable, to increase the frequency range of the speaker system. It is well known today that the prime necessity in attempting to produce a high-fidelity sound system is to reduce all forms of distortion as much as possible, and that until this is done, any steps taken to increase the frequency range of the system can result in a much worse-sounding kind of reproduction than before. The large reduction in distortion that can be achieved by the means under discussion therefore makes it possible to use a much wider frequency range without encountering any of the unfortunate effects common to so many so-called high-fidelity or wide-range systems of the past. This is brought about both because of the lower distortion, and because it is possible to build specialized loudspeakers much more readily than to build single speakers with extended response curves. That is to say, a high-frequency speaker, or "tweeter" as it is often called, that is not asked to reproduce frequencies lower than, say, 1000 c/sec. can be made to perform well up to much higher frequencies than usual, while up to a point, the low-frequency speaker that is specially designed as such can be made to out-perform one which has also to reproduce the highs.

But even at the risk of labouring the point, even if one cannot afford the luxury of a special bass speaker and a cellular horn type of tweeter, the lower distortion of the dual system makes it well worth while to use it even with a pair of relatively inexpensive, unpretentious speaker units.

THE DIVIDING NETWORK

Granted that the above remarks are true, it remains to be seen what is involved, practically, in constructing a dual-unit speaker system. First of all, there is the necessity for seeing that each speaker is fed only with the frequencies to which it is required to respond. Speakers that are specially designed as bass or treble units are usually arranged so that their response falls off rapidly outside the range for which they are designed. This helps, but it is not possible to feed the whole audio

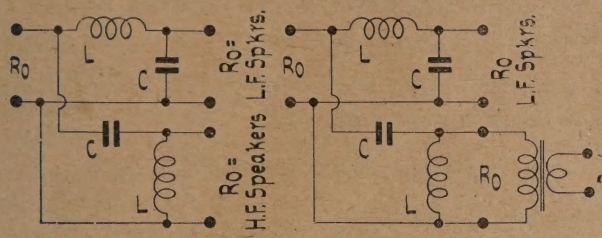


Fig. 1

range to both of them, allowing them to do their own discrimination. If this were done, the cure would most likely be worse than the complaint. We must somehow provide an arrangement which slices the audio range into two, with the lower half fed to the bass speaker, and the upper half to the tweeter. Such an arrangement is known as a dividing network. It can assume a number of forms, but the most usual are those shown in Fig. 1. At (a) we have two L-shaped sections, each containing inductance and capacity, whose inputs are connected in parallel. The two outputs are used to feed the speakers, while the undivided audio is fed into the common input terminals of the network. A feature of the scheme is that as well as dividing the frequency spectrum into two, the network acts as an impedance matching device, so that if, for example, the input is fed from a 15-ohm tap on the output transformer of the amplifier the two outputs each need to be terminated in 15 ohms. Thus, if the two speakers are each 15 ohms, they can be directly connected to the ouput terminals of the network. The arrangement of (b) is identical except for the fact

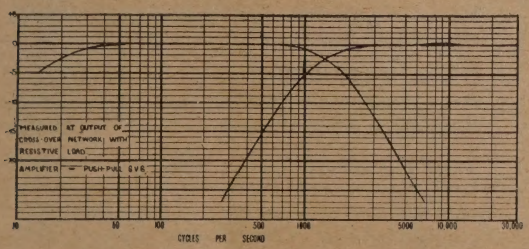


Fig. 2

that the input ends of the two filter sections are connected in series rather than in parallel. Otherwise, exactly the same considerations apply to both circuits.

The frequency response of such networks consists of two separate curves, one for each section, as shown in Fig. 2. Here it can be seen that at some particular frequency, the curves cross. In practice, this frequency is called the cross-over frequency, and if the network is properly designed, it occurs where each curve is 3 db. down from the maximum response, far from the cross-over frequency in either direction. The important things about the network are (1) that the cross-over should occur at the required frequency; (2) that the attenuations realized at half and twice that cross-over frequency should be not less than 6 db. down, and preferably, not more than 12 db. down. The first of these points is looked after by using the correct formulae to work out the circuit constants, and then by seeing that the values of inductance and capacity actually used are those indicated by the calculation. The second point is taken care of in two ways. First, by using an appropriate filter circuit, and secondly, by ensuring that the Q of the inductors is high enough. In actual fact, none of these things present any difficulty, and it is really the purpose

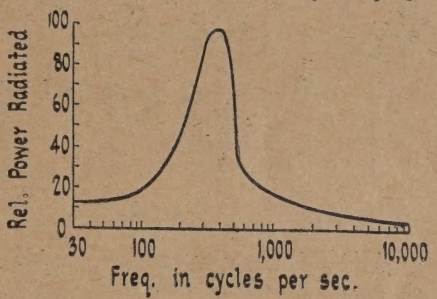


Fig. 5

of the present article to outline the steps that need to be taken to ensure a successful result.

CHOOSING A DIVIDING NETWORK CIRCUIT

Although there are a number of possible circuits, two of which have already been illustrated, it is proposed only to go into details about two of them. For instance, for every parallel circuit there is a corresponding series

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circuit, and there is hardly ever any particular reason for preferring one as against the other. For the sake of uniformity we will take only the parallel circuits, which are shown in Fig. 3 (a) and (b). Now as will be explained (b) is really two circuits, because it is possible to choose two sets of values which give almost but not quite the same result. This will be discussed later. Fig. 3 (a) is the simplest possible type of dividing network,

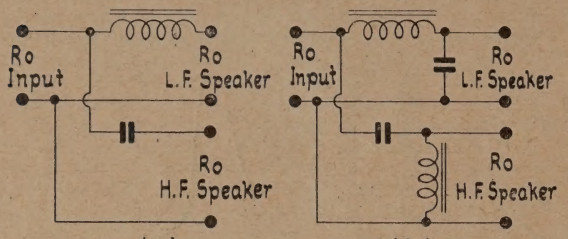

Fig. 3

consisting of a single coil and condenser. Its advantage is that it costs approximately half of what the more complex ones do. Its performance is satisfactory, but just comes within the minimum requirement for attenuation of the unwanted frequency range. That is to say, the attenuation is approximately 6 db. per octave (2/1 frequency ratio). It is useful where expense is a consideration, and where the absolute best is not required. For instance, if two cheap speakers, such as a pair of ordinary 8 in. or 10 in. speakers are to be used, this simple network is in keeping with the rest of the equipment. It has the advantage that it can always be expanded later, if desired, without wasting the parts it uses, until it becomes one of the Fig. 3 (b) networks.

Fig. 3 (b) networks can be designed in two ways. The so-called constant-resistance method has the advantages of presenting a very constant load with variation of frequency, and of having both coils and both condensers equal, making it easy to construct. Its attenuation is approximately 10 db. per octave. The m-derived type has exactly the same circuit configuration, but slightly different values of inductance and capacity. It does not present quite so constant a load, but has an attenuation of 12 db. per octave. Either type can be made to give excellent results.

"FERROXCUBE" POT CORES

Later in this article we will give the formulae by which the required inductances and capacities for any of the three types of network can be worked out, given the impedance at which it is desired to work, and the value of the cross-over frequency. This is quite simple for all of them, and at this stage needs no further comment, so we will proceed to the practical problems. For the sake of illustration, let us take an example of a simple network of the type of Fig. 3 (a). This is to feed two 15-ohm speakers, and itself is to be fed from the 15-ohm winding of an output transformer. The cross-over frequency is to be 1000 c/sec. The appropriate formulae show that under these circumstances, the inductance should be millihenries, and the capacity 10.6 μf. What sort of coil and condenser will be needed?

At first sight, the figure for the inductance brings to mind a small coil wound on a $\frac{1}{2}$ in. former with not very many turns of wire. Would a small R.R. choke not fill the bill?

(To be concluded.)

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VALVE NEWS

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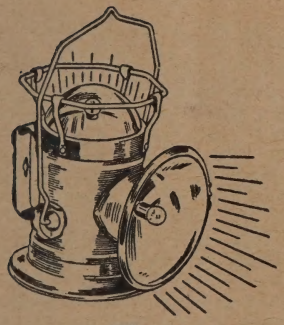

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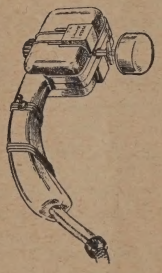

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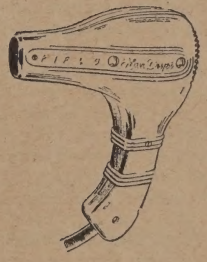

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Special Tubes for Industrial Applications

Electron tubes of the receiving class are finding increasing use in applications broadly classified as "industrial." These applications occur in many varieties of control circuits such as control circuits for temperature regulation, control circuits for the starting, stopping, and speed regulation of motors, and control circuits for lighting equipment. Other applications are found in computing machinery, in measuring equipment, and in counting and sorting devices. Many of the uses of electron tubes in communications, including broadcasting, should be included. Another group of applications includes railway signalling equipment, navigation equipment, devices for overload and overspeed protection, and devices for the protection of machine operators.

medium-mu twin triode similar to type 6SN7-GT, and type 5693 is a sharp-cutoff pentode similar to type 6SJ7. The basing connections for types 5691, 5692, and 5693 correspond to those for type 6SL7-GT, 6SN7-GT, and 6SJ7, respectively, so substitutions may be made when operating conditions are within the ratings of the Special Red tubes and the service requirements are such as to justify their use. The higher heater current, of course, must be taken into account when the substitution of type 5691 for type 6SL7-GT is considered.

Long life for the Special Red tubes is assured by the choice and inspection of the materials used in tubes, by the use of careful processing and assembling, and by

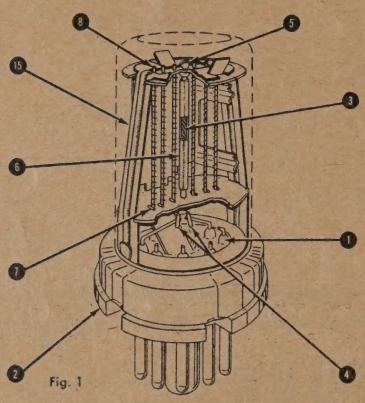

Fig. 1

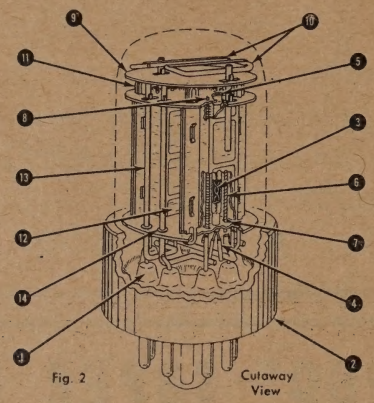

Fig. 2 Cutaway View

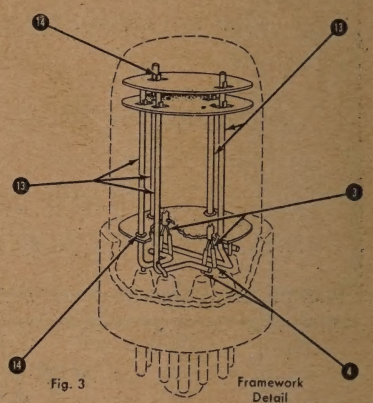

Fig. 3 Framework Detail

Broadly speaking, industrial applications can be considered to include all types of equipment in which the primary considerations of design and use are revenue or safety. The requirement of revenue or safety takes in applications such as those listed above, but generally excludes the use of tubes in home receivers or in toys. In a typical industrial application uninterrupted tube performance is necessary for the preparation of a product, or the maintenance of quality, or (as in broadcasting) the maintenance of a service from which revenue is obtained. The unexpected failure of a tube in industrial service can frequently result in a monetary loss far greater than the initial cost of the tube itself. However, the failture of a tube in a home receiver generally is only a matter of inconvenience and the cost is no more than the tube replacement cost.

RCA has recently announced three new tubes, 5691, 5692, and 5693, called Special Red tubes, which have been developed to meet the demands of industrial applications. It is the purpose of this article to describe the many special features incorporated in the design and manufacture of these tubes and to discuss the significance and importance of these features in critical industrial applications where reliability, ruggedness, and long life are essential.

PERFORMANCE FEATURES

These three types are very similar in electrical characteristics to three popular types used in receiving and other equipment. Type 5691 is a high-mu twin triode, similar in characteristics to type 6SL7-GT except for the amount of heater current required. Type 5692 is a

conservative ratings which provide for moderate current per unit area from the cathode and for moderate power dissipation per unit area for the plates and grids. Pure tungsten wire is used in preference to alloy wire for the heaters because tungsten wire has greater strength. Nickel tubing is used around the heater wires at the weld junctions to the stem wires to secure a stronger weld and thus to prevent breakage or burnouts at these points particularly under conditions of frequent "on-off" switching. The heaters for the separate units for the twin-triode types, 5691 and 5692, are connected in series; this arrangement permits the use of heavier heater wire. In addition, series connection of the heaters in twin-unit types is preferred in many industrial applications because "fail-safe" considerations make it desirable that a heater burn-out render both sections inoperative simultaneously. When Special Red tubes are operated within ratings, their average life should be well in excess of ten thousand hours. This figure represents about fourteen months of continuous round-the-clock service. Long life is especially important in devices or systems using a large number of tubes and in cases where replacement of a tube presents unusual difficulty or expense.

Uniformity and stability of characteristics for an individual tube during its life and among tubes of a given type are very important in industrial applications. Uniformity among tubes is achieved by great care in the selection and inspection of materials, gauging of parts, and inspection and testing of the tube assemblies before they are sealed in their enclosures. In addition, numerous tests are made on the finished tubes and the limits employed are much closer than for other tubes. The Special

Red tubes are seasoned for a long period before final testing. This processing minimizes changes in characteristics during operation which would result from variations in contact potential and exposes any excessive changes in characteristics which would be indicative of premature failure. The precautions taken to ensure uniformity and stability lead to exceptionally good balance between sections in the twin-triode types, 5691 and 5692. They may, therefore, be used without balancing adjustments in many applications. In more critical applications, the range required for balancing controls is minimized and the balance obtained by adjustment is maintained for long periods.

Ruggedness is achieved, primarily, by the use of rigid structures. This feature is important because industrial applications include some in which vibration is difficult to avoid and in which tubes may have to operate under severe impact conditions.

STRUCTURAL FEATURES

Fig. 1 shows the construction used for type 5693. For this type an all-steel A-frame structure (15) is used to support the electrode assembly. The A-frame support is welded directly to a steel ring; a glass button (1) sealed inside this ring carries the leads connecting the electrodes to the base.

Figs. 2 and 3 show the construction used for types 5691 and 5692. The electrode assembly is held together by five supporting rods (13) welded to eyelets (14) in the top and bottom mica insulators. A third mica disk (9) is supported by two of these rods; this disk prevents the material evaporated from the two getters (10) from reaching the electrodes. The electrode assembly is supported by eight lead wires in a button-type stem (1). The total support given by the lead wires is very rigid, although the individual wires are soft enough to prevent excessive stress in the glass seal.

Some of the features common to all three Special Red types are:

1. The cathode has an embossed ring (5) near its upper end. This ring is pressed against the lower side of the upper mica insulator and the part of the cathode sleeve extending above the mica is then squeezed and welded to clamp the cathode sleeve in position. A very close fit between the cathode sleeve and the holes in the mica insulators is maintained. The effectiveness of this method of assembly in reducing variations in characteristics under vibration and shock conditions has been proven in many types where stability of characteristics and low microphonics are necessary.

2. The supporting wires for the grids are provided with metal stops (7) to prevent the distortion of the fine grid wires which could result from vertical displacement of the supporting wires in the mica insulators.

3. The fit between the grid support wires (8) and the holes in the mica insulators is so close that some pressure is required to force the support wires through the insulators. As a consequence, more time is required by an operator to put a tube together, but the tube is sturdier and much harder to shake apart.

4. The red bases used on the Special Red tubes are made of materials which insure low moisture absorption and very high resistance between terminals under high-humidity conditions. The bases are moulded with barriers between the pins to reduce leakage even further.

QUALITY CONTROL

All of the Special Red tubes are tested during manufacture under vibration to detect any looseness which might cause premature failure. Life-test data show that tubes are capable of withstanding hundreds of hours with less than 10 per cent. change in important characteristics continuous vibration at 20 cycles per second and 2.5 *g* acceleration with full voltage applied. Shock tests with impact accelerations as high as 500 *g* have been made on the Special Red tubes. These tests indicate that the tubes can withstand impact shocks of 100 *g* for extended periods and impact shocks of 500 *g* for periods.

The plate current versus grid-No. 1 voltage characteristic of type 5693 is checked against both maximum and minimum limits at a control-grid bias approaching cut-off as well as at a typical operating condition. The plate current versus grid-No. 3 voltage characteristic for this type is also checked to insure uniformity of performance in applications for which this characteristic is important.

Types 5691 and 5692 are tested for balance between sections in order to exclude the possibility of both maximum and minimum values of allowable plate current occurring in the two units of the same tube.

The grid current limits used in testing the Special Red tubes are of particular interest. The maximum allowable signal-grid current for type 5693 under the test operating conditions is 0.10 microampere; this current would produce a shift in voltage of only 0.5 volt when a grid resistor of 5 megohms is used. Grid resistors of higher value (Fig. 4) may be used when the circuit employed includes either bias from a cathode resistor in the screen circuit. The grid currents allowed under test operating conditions for types 5691 and 5692 do not exceed 0.20 microampere per tube.

APPLICATIONS

The Special Red tubes are, in general, intended for use in the same manner and the same circuits as their re-

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ceiving-type counterparts. The applications suggested below point to some of the features of these tubes.

Type 5693 can be recommended as a high-gain audio-frequency amplifier, or a D.C. amplifier, particularly when the source of input signal is a photo-tube, a crystal, or a similar high-impedance source. The low value of high current and the low-leakage non-hygroscopic base are features which are particularly important for this type of service. When type 5693 is used as a D.C. amplifier, the stabilization of contact potential obtained by seasoning becomes an important advantage. Use of the suppressor grid as an additional control electrode can be recommended for type 5693 because the suppressor characteristic of this type is held within specified limits.

Types 5691 and 5692 are useful as audio amplifiers or as D.C. amplifiers and have the same advantage over receiving-type tubes as type 5693. The Special Red twin triodes can be particularly recommended for applications in which good balance between the two sections is required. In addition, other features of these tubes make them desirable for multi-vibrators, cascaded amplifiers, and for other applications in which uniformity, reliability, and extremely long life are essential.

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U.H.F. Power Measurements

By the Engineering Department, Aerovox Corporation

Although the methods used to measure the R.F. power output of ultra-high frequency oscillators and amplifiers differ considerably from the techniques employed at lower frequencies, they are in some respects more direct and accurate. Most of these methods convert the radio frequency energy to be measured into heat in a resistive material and then compare some manifestation of this heat with an equal effect produced by an easily measured D.C. or low-frequency A.C. power. Thus, such systems are self-calibrating, and are limited in accuracy only by the extent to which the incident power is totally absorbed in the lossy material, the sensitivity of the power indicating means, and the precision with which the calibrating power is substituted and measured.

The general types of U.H.F. power meters may be classified according to which manifestation of heat is employed. The three mostly frequently used are:

(a) Lamp loads (light).
(b) Bolometers and thermistors (resistance change).
(c) Calorimetric loads (temperature rise).

Because of the individual characteristics and limitations inherent in each of these methods, their use is generally confined to different fields of U.H.F. power measurement. These characteristics and special applications will be considered here.

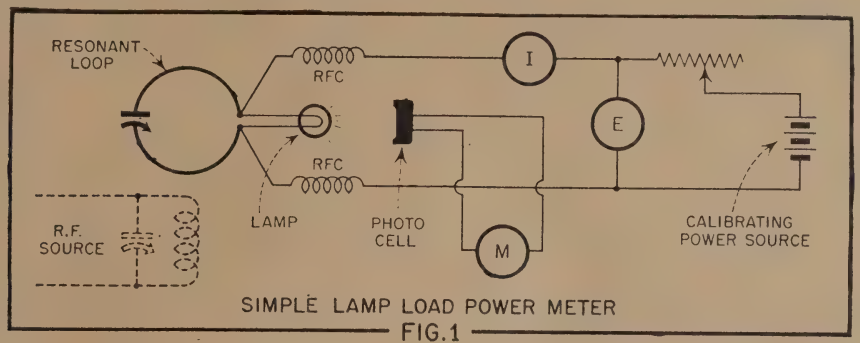
POWER DETERMINATION BY LAMP LOAD

At the low frequency end of the U.H.F. spectrum, the power delivered by a signal source may sometimes be measured by using it to light the filament of one or more incandescent bulbs and then measuring the amount of power from a known source required to produce the same illumination. A photo-electric cell or photographic exposure meter is usually used to indicate the relative light intensity.

Fig. 1 shows the essentials of a typical system using a lamp load. The lamp is connected in series with a resonant L.C. circuit coupled inductively to the R.F. power source. The calibrating A.C. or D.C. power is connected to this circuit through R.F. chokes which prevent the leakage of R.F. power into the calibrating circuit. The calibrating power source should be variable and metered by a watt-meter or voltmeter-ammeter combination.

Power measurement by lamp loads is usually limited to frequencies below 1000 megacycles/second by radiation losses, and by the fact that the filament in which the power is dissipated must be short compared with the wavelength of the power being measured. Otherwise, standing waves will exist on the filament, with corresponding variations in brightness. Power measurements are also limited to the range of powers which can produce incandescence in a filament. This range is from several hundred milliwatts to several hundred watts.

At best, power determinations by lamp load methods are capable of only fair accuracy and so are used principally for quantitative measurements with open-wire circuits.



SIMPLE LAMP LOAD POWER METER

FIG. 1

BOLOMETER AND THERMISTOR BRIDGES

Most conducting materials, including all metals, exhibit a resistance change when heated. This property is utilized in a family of devices known as "bolometers" and "thermistors" to make accurate power measurements over a wide range of power and frequency. Typical constructions are illustrated in Fig. 2. The temperature sensitive element is hermetically sealed in a glass bead, or capsule, and fitted with connecting leads. In the case of the bolometer, the element is a fine platinum wire only a few ten-thousandths of an inch in diameter. Another

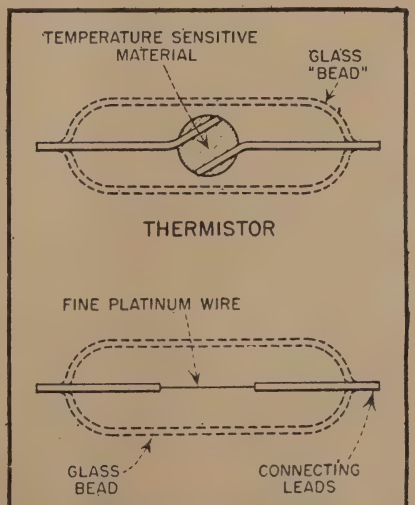
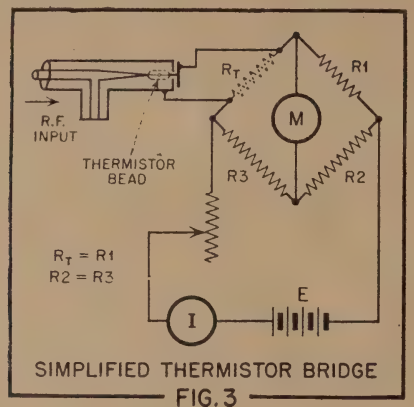


FIG. 2

name for such devices is "barretters." The element in thermistors consists of a compound of metallic oxides fused between the connecting leads. The resistance-temperature coefficient of thermistors is negative rather than positive, as in the pure-metal bolometers, and is numerically larger. Thermistors are therefore capable of somewhat greater sensitivity, as well as exhibiting better overload characteristics.

In measuring power with temperature sensitive elements of this type, the transmission line carrying the power is terminated in the bolometer or thermistor so



SIMPLIFIED THERMISTOR BRIDGE
FIG. 3

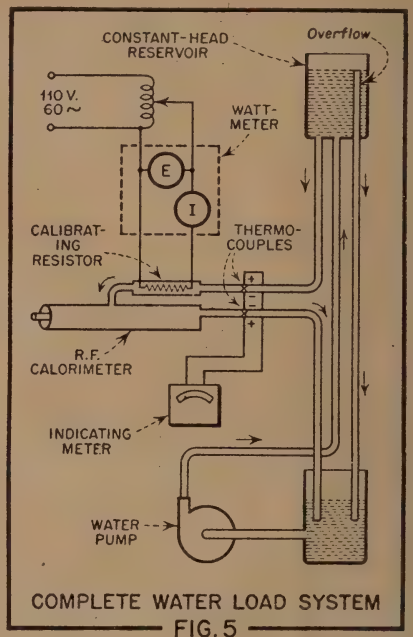
that all incident power is dissipated in the temperature sensitive element. The resulting temperature rise causes a corresponding resistance change in the element, which is also connected to form one arm of a Wheatstone bridge circuit, as in Fig. 3. This bridge is usually balanced prior to the introduction of the R.F. power, so that the resistance change in the thermal element causes an unbalance current which is directly proportional to incident power to flow in the meter. The actual R.F. power is determined by measuring the amount of A.C. or D.C. biasing power which must be subtracted from the bridge circuit to re-balance it. Bridges used in this manner are called "balanced bridges." The bridge may also be used as an "unbalanced bridge" by assuming that the meter deflection is linear with power, as it is when used within the power ratings of the element, and calibrating it against a balanced bridge at one or more points.

By nature of their construction, temperature sensitive elements of the bolometer and thermistor type are limited to the direct measurement of low power. Very accurate power determinations are possible in the range between one microwatt and several milliwatts. This range may be extended to very much higher power levels through the use of attenuators or directional couplers of known attenuation.

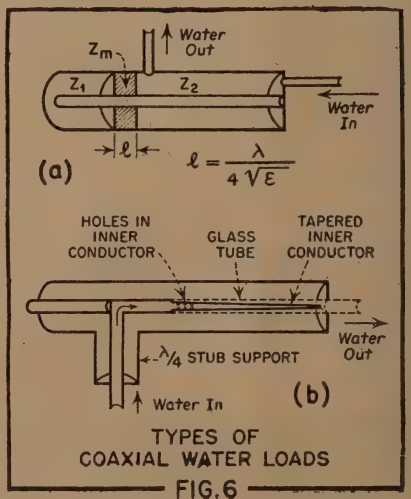
To achieve good accuracy with bolometer or thermistor bridge measurements, all of the incident power must be dissipated in the thermal element. In other words, the resistance of the element must match the impedance of the transmission line at the frequency of the incident power being measured. Methods have been evolved of mounting elements of this type in both coaxial and waveguide transmission lines so that a good match exists over bandwidths of at least 50 per cent. Examples of typical "broad-banded" thermistor mounts are shown in Fig. 4. A standing wave indicator is usually used in conjunction with such mounts to measure the degree of match existing between the line and the load. Since the resistance of the thermal element varies with temperature, it may be made to present a better match by adjusting the bridge current flowing through it.

CALORIMETRIC LOADS

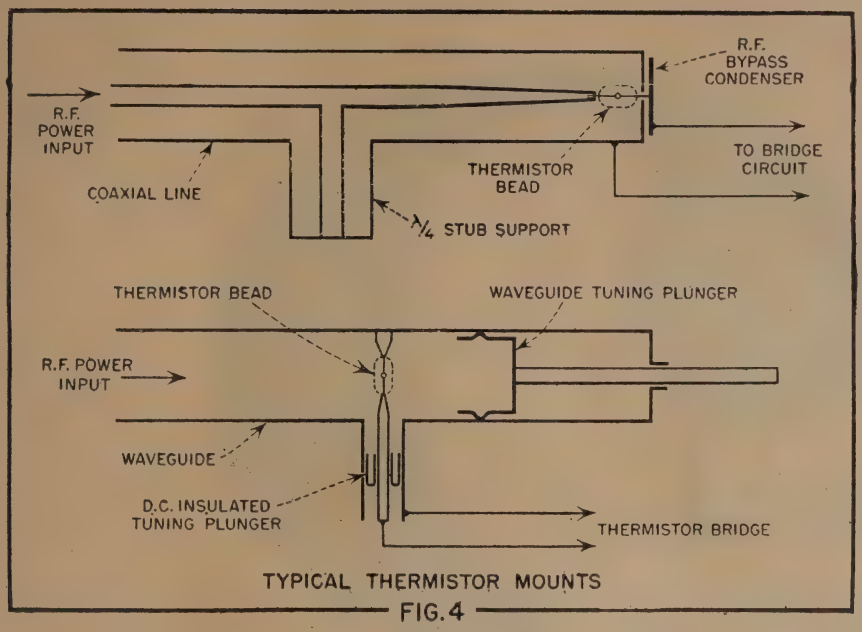
The third type of U.H.F. power meter which is in common usage is the calorimeter or "water load." In this method, the power to be measured is absorbed in a column of water or other liquid which circulates through a section of the transmission line. The power dissipated in the liquid results in a temperature rise which is measured by thermometers or thermocouples and is directly porportional to the R.F. power. If the liquid used is water, and the rate of flow and temperature rise



COMPLETE WATER LOAD SYSTEM
FIG. 5



TYPES OF COAXIAL WATER LOADS
FIG. 6



TYPICAL THERMISTOR MOUNTS

FIG. 4

are known, the power may be calculated by:

Average power (watts) = 4.18 F ΔT

Where:

F is the flow rate in cubic centimetres/sec.

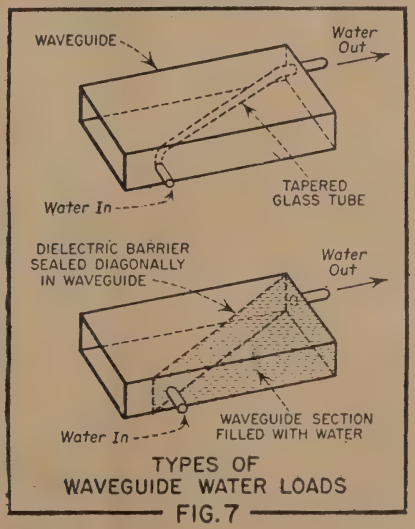
ΔT is the temperature rise measured. (Degrees C.)

This calculation is eliminated in some modern calorimetric systems by resorting to power substitution. For this method no knowledge of the rate of flow is required, although a constant rate must be maintained. A diagram of a system of this type is given in Fig. 5. The transmission line is terminated by the calorimeter load. Water flows through this load at a constant rate, as determined by the constant-head reservoir. A pair of temperature indicating devices, such as thermometers or thermocouples, are mounted in the water stream near where it enters and leaves the calorimeter. An A.C. or D.C. calibrating load resistor is also mounted between the points of temperature measurement, which are arranged to indicate the temperature *rise* between them. In the case of thermocouples, this is done by connecting the "cold" and "hot" junctions in opposition. Thus, the meter reads zero until there is a temperature increment due to heat in the R.F. or A.C. loads.

To measure power with this water load, the meter deflection is noted with the R.F. source turned on. This power is then removed and an equal deflection is produced by substituting low frequency calibrated power in the load resistor. If the thermal conditions for the load resistor are similar to those of the R.F. load, the calibrating power required to produce the same deflection will be equal to the R.F. power and can be read directly from the wattmeter.

The errors in this system can be reduced to a very low minimum. The water flow is usually selected so that the temperature rise is only a few degrees above room temperature, thus minimizing errors due to heat radiation from the water tube. Another possible error arises from the fact that heat produced in R.F. load undergoes additional losses in flowing through the calibrating resistor, or conversely, depending on the direction of water flow. This error could be virtually eliminated by mounting the resistor in the same place in the calorimeter that the R.F. power is absorbed. However, for reasons of impedance matching which will be discussed later, this is usually impractical. A reasonable compromise can be had by designing the load resistor in two parts so that half of the calibrating power is substituted on each side of the R.F. calorimeter. In this manner half of the calibrating power undergoes more losses than the R.F. produced heat while the other half experiences less. Thus the error tends to average out.

In the design of calorimetric power absorbers, several requirements must be met. The water column must be a good impedance match over the frequency range, so that all power is absorbed. The volume of liquid heated must be large enough to dissipate the power to be handled, but must not be too large; otherwise the response will be very sluggish.

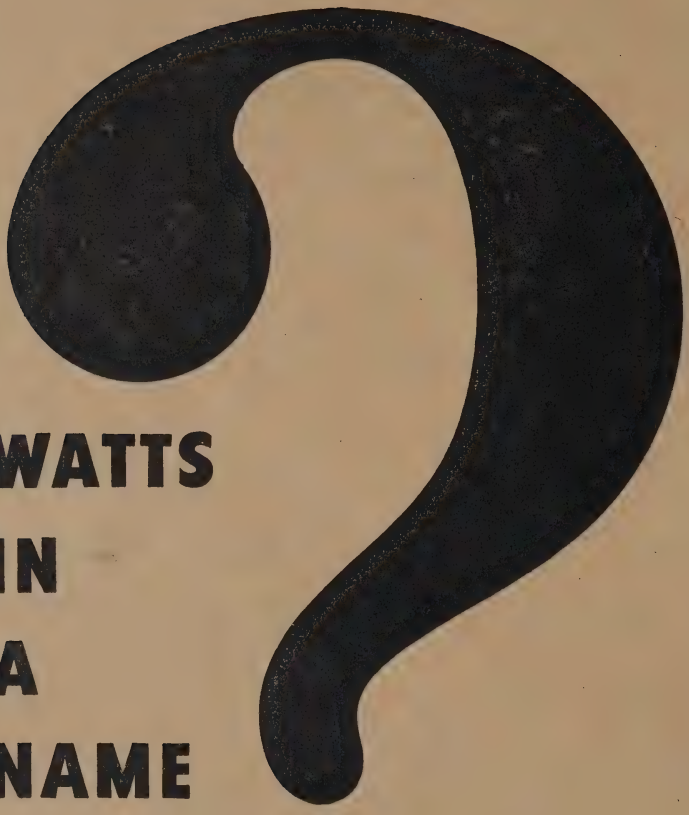


TYPES OF WAVEGUIDE WATER LOADS

FIG. 7

Fig. 6 shows two designs which have been used with coaxial lines. The load illustrated at 6a makes use of a quarter-wave dielectric bead transformer to effect an impedance match between the air-filled line and the

(Concluded on Page 48.)



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P3.

THE "RADIO AND ELECTRONICS" ABSTRACT SERVICE

ANTENNAE AND TRANSMISSION LINES

It has been discovered that it is possible to reduce skin effect losses in transmission lines by laminating the conductors and adjusting the velocity of transmission of the waves. The modes of transmission are analysed and also termination problems.

—*Proceedings of the I.R.E.* (U.S.A.),, July, 1951, p. 767.

If an aerial fed by a waveguide is to be rotated, one or more rotating joints will be required between the fixed waveguide and the feed. The paper describes most of the known forms of joint so that those needing such may be able to find the most suitable.

—*Electronic Engineering* (Eng.), September, 1951, p. 332.

There is unusual interest in the design of effective mobile antennae. Low frequency rigs are very critical of adjustment to resonance. A device is illustrated with a simple loading coil construction to obviate this difficulty.

—*QST* (U.S.A.), August, 1951, p. 37.

The theory of transmission lines. The article deals simply with the characteristics, attenuation constant, velocity factor, surge impedance. A valuable explanation for the beginner.

—*Radio and Hobbies* (Aust.), October, 1951, p. 31.

AUDIO EQUIPMENT AND DESIGN

In sound recording the studio provides the link between the matter to be recorded and the microphone, so that the studio is part of the equipment. The article explains typical defects, reverberation, distribution of absorption material, with charts to assist designers.

—*Wireless World* (Eng.), September, 1951, p. 359.

One of the most puzzling features of magnetic recording is the use made of supersonic or A.C. bias. This is a complicated problem, but the article gives the reader an elementary conception of what is required and accomplished.

—*Radio and Hobbies* (Aust.), September, 1951, p. 57.

Interesting notes on some of the difficulties arising in the construction of the Williamson amplifier and some sound common sense on amplifiers generally with a design of an amplifier using 807's that will do all that anybody can reasonably require.

—*Ibid*, October, 1951, p. 36.

National Union Radio Corporation has developed for audio a new tube combining the best features of the triode and the beam tube. It is a space charge tube with unusual characteristics, and intended to simplify and improve audio design.

—*Audio Engineering* (U.S.A.), September, 1951, p. 15.

Design data for a bass reflex cabinet. This form of cabinet is described with a series of charts for designing under different conditions and parameters.

—*Ibid*, p. 18.

The measurement of audio volume. A comprehensive discussion of the problems involved and the instruments employed to indicate programme level and sine-wave tones in broadcasting and recording circuits.

—*Ibid*, p. 26.

CIRCUITS AND CIRCUIT ELEMENTS

It is well known that a crystal has an impedance varying with frequency. If a reference impedance is given a value between the resonant and anti-resonant frequencies, action as a frequency discriminator is apparent. A simple circuit, therefore, is available for discrimination.

—*Proceedings of the I.R.E.* (U.S.A.), July, 1951, p. 783.

A magnetic modulator of the even harmonic type is a simple and robust device for efficiently converting a weak direct current to a linearly practical A.C.

—*Wireless Engineer* (Eng.), September, 1951, p. 281.

ELECTRONIC DEVICES

The radio control of model aircraft; principal control systems contrasted and the methods of proceeding by smooth movement or by jerks; escapement types; pulse width control, also a tuned reed and modulator system.

—*QST* (U.S.A.), August, 1951, p. 12.

For checking radiation after an A-bomb blast an instrument is required that will respond to intensity of radiation rather than to the number of particles. Such an instrument is the ionization chamber, the construction of which is considerably more critical than that of the Geiger counter, but the operating principles are quite simple.

—*Ibid*, p. 20.

Radio telearchies is the operation of controls from a distance. This is a further article on the control of models. A description of a device for steering a boat is described.

—*Wireless World* (Eng.), September, 1951, p. 342.

INSTRUMENTS AND TEST GEAR

The problems of matching a load to a source and the subsequent measurement of power transfer is not simple at high frequencies. A simple directional power meter for the band 150-250 mc/sec. is described. Both forward and reflected power are indicated by the meter.

—*Wireless Engineer* (Eng.), September, 1951, p. 278.

Various types of Army and Air Force indicator instruments are now sold as surplus and the article gives ideas on how these may be adapted to serve as useful instruments, ammeters, etc.

—*Wireless World* (Eng.),, September, 1951, p. 376.

Research on the acoustics of halls and studios frequently involves the use of portable apparatus for making tests. The special equipment described can be made light and compact and will allow an exploration of the acoustics of the hall to be made.

—*Electronic Engineering* (Eng.), September, 1951, p. 326.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

A new form of transistor, the n-p-n type is described which comprises of a thin layer of p type germanium interposed between regions of n type. The p type is connected to the base and the emitter and collector are attached respectively to the n sandwich. The operation of these is very interesting and shows a great step forward in the development.

—*Proceedings of the I.R.E.* (U.S.A.), July, 1951, p. 753.

Raw materials for certain of the ceramics used in the electrical industry have come from Bavaria, Italy, and Egypt. Notes given on the making of ceramic ware and on the properties of pyrophyllite, obtainable from the Transvaal which is excellent for many purposes.

—*Electronic Engineering* (Eng.), September, 1951, p. 336.

More and more demands made on the cathode have produced the L type design which is formed of molybdenum with barium strontium carbonate and a cap of porous tungsten. Emission is greatly increased, poisonability reduced and resistance to high voltages increased.

—*Electronics* (U.S.A.), August, 1951, p. 105.

MATHEMATICS

More about the binary scale and its use in electrical calculating machines. The scale is explained in relation to the working of the valve and the article is an introduction to calculating machines.

—*Wireless World* (Eng.), September, 1951, p. 354.

More information on the electronic digital computator with special reference to the special Dekatron tubes with 10 separate cold cathodes and notes on the translator unit, sequence control, setting up of connections, the arithmetic operation, etc.

—*Electronic Engineering* (Eng.), September, 1951, p. 341.

A description of a small automatic computor "Nimrod." It calculates; it remembers; it makes decisions. It will play the game "Nim," a mathematical game played with matches, and was used for demonstrations at the Festival.

—*Ibid*, p. 344.

RECEIVERS

The advent of power cuts in England has forced many to consider again the old crystal receiver as an alternative to missing the programme altogether. An astonishing amount of interest has been taken in the new crystal sets, one of which, a great advance on the old types, and with germanium diodes, is described.

—*Wireless World* (Eng.), September, 1951, p. 338.

A design of an excellent regenerative receiver for the novice designer. One 6SJ7 and one 6SN7 are used and the set will work from a 45-volt battery. A simple design for the boy who is not allowed to tinker with normal power supplies.

—*QST* (U.S.A.), August, 1951, p. 24.

TRANSMITTERS AND TRANSMITTERS

Many experts still regard sterephonic broadcasting as the system of the future and do not see any overwhelming objections to two channels. A proposal has been made that the vision transmitter should provide the second channel, or provide several second channels inside its bandwidth.

—*Wireless World* (Eng.), September, 1951, p. 371.

Detailed plans of a 30-watt band-switching exciter-transmitter for 3.5 to 50 mc/sec. A feature is the seven bands and band-switching circuitry. Valves 5763 are used in three conventional stages.

—*QST* (U.S.A.), August, 1951, p. 15.

TELEVISION

Plans for compatible colour television. The system involves the transmission of a high-quality black and white picture signal plus a sub-carrier within the video band which carries the colour information. This may have advantages on the sequential system, and a committee has been set up to investigate its possibilities.

—*Electronics* (U.S.A.), August, 1951, p. 90.

MISCELLANEOUS

Electronic heaters are very likely to produce radio interference in spite of all attempts at shielding. The problem resolves itself to a study of complete shielding and the article describes where "leaks" are likely to occur and methods of blocking them.

—*QST* (U.S.A.), September, 1951, p. 29.

SHOES and SHIPS

"The time has come," the Walrus said,
"To talk of many things. . . ."

By Special Arrangement with the Walrus

Speaking of Speakers

In the never-ending search for high-fidelity sound reproduction one of the most important links in the chain from record to speaker is undoubtedly the speaker itself. It is also probably the one unit in which less progress has been made than any other, for most types are still very inefficient and have anything but a smooth response curve compared with the capabilities of a modern amplifier.

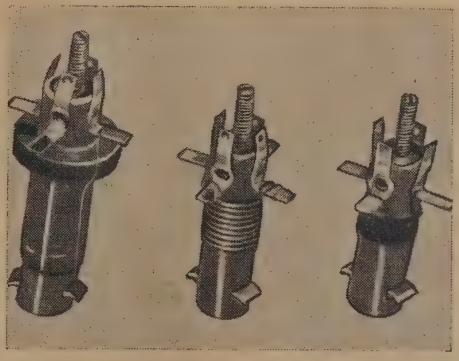
However, when one comes to consider how a piece of parchment can be made to give forth sounds like an organ one minute and a piccolo the next, they can't be considered to be too bad. The amazing part about it is that with so many brilliant brains interested in sound reproduction no more successful method of converting electrical impulses to audible sound has ever been evolved. Let us hope that these few words will stimulate some reader to produce a type involving a different principle. For the enlightenment of budding scientists, something a little smaller than a "K" locomotive is considered desirable!

Returning to our theme, one of the greatest difficulties encountered in speaker design is in making a cone of suitable material compatible with the frequency range to be handled in the audio spectrum. The lower frequencies require a cone of considerable area and robustness in direct contrast to the higher frequencies which need a very light stiff cone having little or no inertia. Much thought has been given to this aspect of speaker design and many methods adopted to overcome these two irreconcilable features. Some manufacturers employ a cone of graded stiffness and thickness from the centre outwards, the cone being stiffened and thinned towards the centre near the voice coil so that short fast excursions of the voice coil have greatest effect on the inner portion of the cone. Others fit a second cone of very light stiff structure at the centre of the speaker directly coupled to the voice coil and then feed the main cone, which is of conventional pattern, from the same voice coil but coupled through a resilient medium. The idea involved is that the light cone responds readily to short fast pulsations which are too small and rapid to drive the main cone through the flexible coupling medium. On the other hand, large movements of lower frequency are transmitted through this resilient coupling and drive the large cone easily since its inertia is not such a handicap at the lower speed. The fact that the small cone also responds to these low frequency pulses is not important since its sound output is quite low due to its small area. This arrangement can probably give rise to intermodulation distortion but certainly does provide a greatly extended frequency range.

Another method employed which is an adaptation of both the previous two is to employ a standard shape of speaker cone but actually divided into two different parts, the first part being a light stiff cone directly coupled to the voice coil and having dimensions approximately the size of a normal 5 in. speaker. This cone is then extended out to full 10 in. or 12 in. size by another cone, the two cones being joined together at their edges by a flexible membrane. The principle involved is that the light cone nearest the voice coil is easily driven at high frequencies, the membrane forming a buffer between the two cones. At low and middle frequencies the whole cone is actuated to reproduce bass passages and give body to the sound.

Another system which has a lot to commend it is to employ two separate speakers, one solely to reproduce bass and middle frequencies and designed with that end in view, the other to reproduce high frequencies and constructed to be most efficient for that purpose. The output from the amplifier is divided electrically and each speaker is fed with the sound frequencies which it is intended to handle. This arrangement brings about a reduction in intermodulation distortion to a marked degree but in the interests of good listening, two speakers of similar efficiency should be used. One overseas manufacturer at least has produced a complete speaker unit along these lines in a very novel manner. The two speakers are combined as one unit, the bass section following conventional pattern having a very free-floating cone of particularly dead material in order to bring the fundamental bass-resonance right down as low as possible. The pole-piece round which the voice-coil works is actually hollow, having a flared or trumpet-shaped hole through its length. At the base of this horn a second speaker is placed and this one is a type of pressure unit with an extremely light and stiff diaphragm.

HY-LINE



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Its efficiency is most marked at high frequencies so when the two units are fed from a frequency dividing network they combine to give very fine results indeed, remarkably free from distortion. It can be seen then that the ordinary common type of speaker is able to be considerably improved upon and we shall discuss possible methods of doing this in a future article.

All modern speakers rely for their principle of operation upon a powerful magnetic field which may be either of a permanent nature or electrically induced. Where speaker fields are concerned the units Oersted, Maxwell, and Gauss lurk and are freely quoted in literature dealing with them.

A high flux density is important and is a criterion of speaker performance. The question is: how are the units related? Firstly, comes the Maxwell, named after that very eminent gentleman who spent more time than most people with a magnet. It is the unit of flux and it can be said that from a unit magnetic pole 4π Maxwells or lines of force radiate. In other words, it is a convenient assumption upon which to base other measurements and terms. A unit magnetic pole, for the sake of the doubtful is one of such value that when placed one centimetre from a like pole a force of repulsion of one dyne exists between them. Now magnetic lines of force do not travel readily through air but prefer another medium (*e.g.*, soft iron) where possible. In other words, they display a reluctance to pass through air and this units of reluctance is the Oersted and is defined as the reluctance offered by one centimetre cube of air. The Oersted and the Maxwell find common ground in a unit termed the Gilbert.

The Gilbert is the unit of magnetomotive force, being that amount which is necessary to force a flux of one Maxwell through a reluctance of one Oersted.

Now comes the most important unit from the speaker point of view—in other words the Gauss. This is the unit of magnetic field strength and is equal to the number of Maxwells per square centimetre when the medium through which the flux is passing is air. Thus the flux density in the gap where a speaker voice-coil works can be quoted as so many Gauss which gives a definite conception of the field strength at that most important point.

BACK NUMBERS OF R. & E.

The following retailers can supply you with a range of back issues as well as current issues of "Radio and Electronics":

Te Aro Book Depot, Courtenay Pl., Wellington.
S.O.S. Radio, Ltd., 283 Queen Street Auckland.
S.O.S. Radio, Ltd., 1 Ward Street, Hamilton.
Tricity House, 209 Manchester St., Christchurch.
Ken's Newsagency, 133-135 Stuart St., Dunedin.
Webbs Radios, Ltd., 11 Wellesley St. E., Auckland.

A Merry Christmas To All!

NO! WE DO NOT GIVE PRESENTS BUT LOOK

through a selection of stocks offering below and we think you may like to buy yourself a present at a good price.

Included in these items are lines being sold on behalf of a manufacturer who has given up business. No War Assets stock is listed.

1S5 Valves	6/–
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110v. 80 ma. Metal Rectifiers	12/6
1-meg. Potentiometers I.R.C.	3/11
1-meg. Potentiometers, with switch (wired, but never mounted)	4/5
Extension Speaker Terminal Boards	8d.
Double-ended Coil Lugs (packets of 25)	3d.
Chassis, light aluminium (mostly without back fold), punched for 5 min. valves Plessey "R" 2-gangs Philips Ferroxcube I.F.s; ideal for battery, portable, or small A.C. sets; approx. 8 x 4	2/6
Litz Wire, 9 x 38, Nyltex 1 lb. reels	19/6
8 mfd. 450v. Condensers (metal case, tubular)	1/11
25 mfd. 25v. Condensers (metal case, tubular)	1/6
0.1 mfd. 200v. Condensers	8d.
0.05 mfd. 200v. Condensers	8d.
0.02 mfd. 400v. Condensers	8d.
0.002 mfd. Condensers 500v. working	6d.
0.001 mfd. Condensers 500v. working	6d.
0.0001 mfd. Condensers Mica	8d.
10 pf. Condensers Ceramic and Silver Mica	9d.
I.R.C. Resistors:	
¼ watt 10, 3, 1, ½ meg. each	4d.
per dozen	2/9
½ watt 10, 5, 3, 2, 1, ½ meg., 75k., 35k., 4k., 1500 ohms, 600 ohms each	4d.
per dozen	3/9
Panama wire-wound Resistors, values from 100 ohms to 5000 ohms each	6d.
per dozen	5/6
Aluminium Spacers, 1½ x 9/64 (approx.) per dozen	10d.

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from

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Obituary

DR. A. F. PHILIPS, OF EINDHOVEN, HOLLAND

The death of Dr. A. F. Philips, of Eindhoven, Holland, head of the Philips Electrical and Radio organization, was announced recently.

Dr. Philips, who was aged 77, has been head of the world-wide group of Philips lamp and radio industries for 55 years. During that time, his energy and enthusiasm, together with his application of scientific research to electrical development, saw the spread of the Philips companies to practically every country in the world. In addition, factories were established in 26 of these countries, including both New Zealand and Australia.

As well as being a commercial leader, Dr. Philips was a great humanitarian. Under his direction the Eindhoven factories were one of the first major industries to apply social welfare to the great body of employees. It was the first factory to apply mass chest survey methods to all its employees as a preventative against T.B. Medical and nursing services were made available free of charge not only to his workers but also to their wives and families. Pre-natal care of expectant mothers was organized and available to the workers over 30 years ago and, in general, Philips' organization pioneered many of those staff welfare amenities which today are expected by the average worker.

Dr. Philips received many international honours including Chevalier of the Legion of Honour, the Order of the Netherlands Lion, the Golden Medal for Energy and Ingenuity, as well as degrees and honours from many universities and technical institutions.

It is not given to many world figures to participate in the 60th anniversary of a world institution which he helped to found, but Dr. Philips had this distinction when in May of this year he was a centre figure in the Philips 60th anniversary.

Many modern medical and X-ray discoveries originated in his laboratories and it can well be said that the world is vastly richer in both physical and humanitarian senses from his living and will be the poorer for his death.

One has but to compare the living conditions of the average household in the 90's with those which are normal today. The electrical home as we know it would have been beyond imagination half a century ago. A vast contribution has been made towards this pool of applied scientific knowledge by Dr. Philips and his collaborators and assistants and almost every dweller on this earth must have benefited by the discoveries and new applications which have stemmed from the Philips world organization.

NZ RADIO TRADERS FEDERATION MEMBER

The Badge that will protect you and add prestige to your business.

MEMBERSHIP PROGRESS

The Wellington Radio Traders' Association recently conducted a membership drive and reports that through the efforts of the sub-committee its membership has nearly doubled and is rapidly approaching the goal set, namely "100 per cent. representation of active retailers and wholesalers in the Wellington Provincial Area."

●

Other Associations including Auckland, Otago and Southland report similar results.

●

Have you filled in the application form? If not, you are losing out by not displaying the Membership Badge and supporting the Federation.

●

Full list of Associations were advertised in October issue of *Radio and Electronics*.

This announcement is inserted by the New Zealand Radio Traders' Federation, Headquarters, 8-12 The Terrace, Wellington.

NEW ZEALAND RADIO TRADERS FEDERATION

A special general meeting of the New Zealand Radio Traders' Federation was held at Wellington on 10th October. Present: Mr. J. Fairclough, President (in the chair), and Messrs. Borham, Christie, Griffith, Souper, Young, Howorth, Billing, and Luxford (assistant secretary).

The chairman welcomed the delegates and referred briefly to his visits to Auckland and Wellington to attend the annual meetings of those associations. He briefly covered the history of the recent difficulty between the Federation and the Auckland Association, and explained that this meeting had been specially called to consider the matter.

CONDENSERS

Mr. Christie (Auckland) expressed the Auckland Association's views on classification of certain firms as wholesale distributors of condensers, and after protracted discussions a motion was passed giving approval to the actions which had been taken by the sub-committee. This was passed by a strong majority, Mr. Christie being the only dissentient.

OBJECTS OF FEDERATION

After Mr. Christie made an explanatory statement, it was moved by him and seconded by Mr. Howorth: "That the Federation approach its affiliated associations to obtain their views as to whether the Federation should widen the scope of its activities by including washing machines, refrigerators, vacuum cleaners, and other major domestic electrical appliances."—Carried.

RADIO INTERFERENCE

Mr. Billing tabled his report of a recent meeting of the Radio Interference Standing Committee, on which he is the Federation's representative. A general explanation of the work of the committee was given by Mr. Billing, and the secretary undertook to distribute copies of the report to associations.

After Mr. Billing had been thanked for his report and the work he had done on the standing committee, it was moved by Mr. Christie and seconded by Mr. Young: "That the report be adopted."—Carried.

TELEVISION TRAINING

A lengthy discussion took place during which Mr. Christie informed the meeting of Auckland's intentions to implement a training scheme.

The discussion was wound up by Mr. Billing moving and Mr. Griffith seconding the following motion: "That a deputation be arranged to see the Minister of Education and the Director of Education with a view to stressing the importance of providing training in radio physics and television principles, and that the deputation should press for the Government to take steps to ensure that adequate facilities be made available for the training of adults and apprentices at the technical training colleges in the four main centres, and that correspondence courses be inaugurated to cater for the other districts."—Carried.

IMPORT LICENCES—WIRELESS RECEIVING SETS

The secretary read a letter that had just been received from the Board of Trade. This letter is being circulated to associations, and reads as follows:—

"I refer to your written objections to the proposed de-control from import licensing of the following Licensing Schedule items:—

Board's Ref. No.	Tariff Item	Description
285	338 (12) (a)	Wireless broadcast receiving sets, etc.
286	338 (12) (b)	Wireless broadcast receiving sets, etc.

"The Board has now further considered the submissions made in respect of these items, and I am directed to advise you that the Board is of the opinion, on the evidence before it, that consideration of the de-control of these items should be postponed until such time as it is able to conduct a detailed review of the protection afforded the manufacturers of products classified thereunder by the present rates of tariff duty. The Board does not propose to conduct such a review before 1st April, 1952.

"No further representations in regard to the de-control of the above items need be submitted to the Board until you are further notified."

MEMBERSHIP BADGE STEREOS

Delegates were asked to remind their association members that these stereos (in two sizes) can now be procured (cost, 4s. 8d. each stereo).

BATTERIES

As no further word had been received from the Board of Trade, the secretary was asked to send another letter.

(Note.—On the day following this meeting, the Board advised that a hearing of interested parties would be held on 14th November, 1951. This letter has been circulated to associations.)

HIRE-PURCHASE AGREEMENTS

After a general discussion, it was moved by Mr. Billing and seconded by Mr. Howorth: "That the Wanganui Association hire-purchase agreement be submitted to the Federation's solicitors for examination and advice, with a view to having it printed for distribution and use by members."—Carried.

TRAINING FOR TELEVISION

In our November issue we referred to a circular released by the A.P.R.T. Association, a copy of which appears below. With this letter was enclosed an outline of the syllabus for the proposed course as well as a form of application. Further details may be re-received from the secretary of the association, J. E. Beachen, C.P.O. Box 611, Auckland.

4th October, 1951.

Dear Sir/s.—As there is every indication that it will not be too long before television broadcasts commence in this country and television receivers sold by radio traders, your association is concerned that means should be provided to assure that present radio servicemen have the knowledge necessary to properly maintain the TV sets sold.

To this end, discussions have taken place between a sub-committee of your executive and the Seddon

College, and arrangements made for the running of a course of instruction in TV techniques; it is emphasised, however, that this course will only be commenced if the names of sufficient radio servicemen trainees are now registered to make classes worth while; if more than sufficient names are registered, then wo simultaneous courses will be commenced. If sufficient support by the trade is shown, there is every probability that an extension of the training will be made to cater for servicemen in the provincial towns.

As the proposed course will consist of classes held one night a week over a two-year period, it will be seen that the first trainees cannot complete the course before December, 1954, if classes are commenced at the beginning of the coming school year as proposed. It seems very likely that by that time the need for trained men in TV will be very real.

It is in your best interest, then, to urge the radio servicemen on your staff to immediately lodge their names with the secretary of this association as signifying their willingness to enrol for this course. It is most important that this be done right away, otherwise the college cannot be persuaded to commence classes next year.

Should a radio serviceman wishing to enrol not be employed by one of our members, it is still urged that he lodge his name with the secretary; it is in the general interest of the trade that as many as possible be trained.

Once again, we ask you to give this matter your urgent attention.

Yours faithfully,
J. E. BEACHEN, Secretary.

Letter to the Editor

Dear Sir,—I wonder if any of your readers could help with information on "electronic tremello" circuits which are used in connection with amplifiers for the electric Spanish guitar?

I heard a commercially-built amplifier using this device —the tremello was variable in depth and frequency. The effect has been heard in this country on records made by overseas artists, and is a tremendous aid to the player.

Would be grateful if you could find space for this letter in your magazine.—Yours etc.,

N. G. ROBERTS.

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Condensers of various types, Radio Valves with International Bases, Cold Triode Relay Tubes, Neon Stroboscopic Lamps, Mercury Vapour and Vacuum High Voltage Rectifiers, also Cathode Ray Tubes will be available shortly.

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B 110 W

Ronette Crystal Microphones, models B 110 W and G 310 are equipped with specially developed "wide-range" crystal units type B D X, ensuring high-quality frequency response from 30 to 10,000 cycles. Crystal units are double moisture-sealed and have automatic barometric compensation.

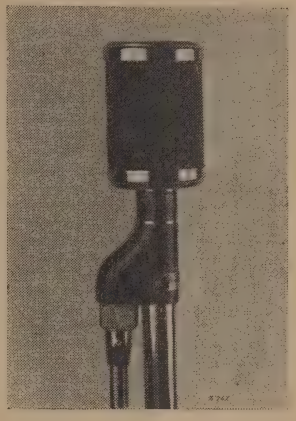
Model B 110 W of the popular torpedo form in graceful plastic head with statical screening against electrical influence from the outside. Normal colours, black and ivory.

Model G 310, with tilting head, robust metal construction for rough work. In horizontal position non-directional operation. In colours dark grey, greyish-green, black. Other colours on demand.

Cellmicrophone S 742: RONETTE cellmicrophone S 742 gives satisfaction to highest demands. By special construction the universal cable and stand-connector can be unscrewed for overhead suspension of the microphone on the cable. Fitted out with two lightweight sound-cell units with greatly reduced dimensions united with sensitivity for sound vibrations and insensitive to mechanical vibrations. Model S 742 is classified among the best studio microphones.

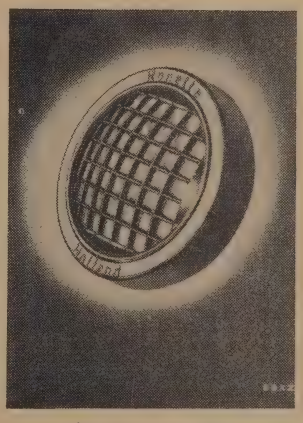
Technical details.—Sensitivity: Equal sensitivity to all directions and for all frequencies. Frequency response from 20 to 14,000 cycles, flat plus or minus 3 db. Voltage: 1.5 mV/uB, measured between microphone terminals across 5 Megohm load resistance at 1000 cycles, equivalent to 56 db. below 1 volt per bar, measured on open circuit. Impedance equivalent to a 4400 pF capacity. Load resistance: 5 Megohm recommended. Max. working temperature: 120 deg. F. or 50 deg. C. Output level and cable length: 50, 100, and 200 feet. Output level cable terminals: 59 db., 62 db., 66 db. Output level expressed in db. below 1 volt per bar. Net weight: 8 oz. (approx.).

Ronette Microphone Cartridge, model B D X. As used in microphone models B 110 and G 310, are available for manufacturer and servicing. All-plastic housing with two eyelet-terminals. Technical details as for B 110 W and G 310 microphones.



S 742

G 310



B D X

"RONETTE" CRYSTAL MICROPHONES are made at the laboratories of N. V. Ronette, Piézo Electric Industry, Amsterdam, Holland.

Sole New Zealand Representatives:

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RADIO ENGINEERS

Phone 54-418 **43 LOWER TARANAKI STREET, WELLINGTON, C.3** **Telegrams: "Fidelatone"**

The PHILIPS Experimenter

No. 50: A Practical S.S.S.C. Generator Using the Phasing Method

The block diagram, Fig. 3, in Experimenter No. 49, showed the scheme of the method to be used in the equipment we are now about to describe for generating a single-sideband-suppressed-carrier signal. In all, ten valves are employed, four of which are taken up by the pair of balanced modulators, and two of which are used as a simple pre-amplifier. The remaining four double triodes are either cathode followers or resistance-coupled audio amplifiers, so that in spite of the apparent complexity, there is nothing in the whole arrangement that need cause alarm or despondency! Anyone who has built himself a conventional A.M. transmitter need have no fear that he will put in a great deal of time and effort only to find the result unsuccessful. Indeed, building the device calls for no special knowledge or skill whatever, and adjusting it, once built, is equally easy, as long as one realizes what the various portions of the circuit do, so that adjustments can be made intelligently rather than in a random manner. This method of getting an S.S.S.C. signal has a number of points about it which should commend themselves to those who like to do things in the easiest possible manner. In the first place, the six or seven pre-set controls are real pre-sets, in that once they have been adjusted, it is possible to leave them severely alone until such time as tubes need changing. Secondly, R.F. is applied to the unit at a level of only a watt or two, *at the operating frequency*. If it is desired to change to another band, all that has to be done is to plug in a different tank circuit at the output, and to turn a switch which brings in different values of L_1 and C_{28}, which are also pre-sets. Alternatively, different output frequencies can be had by leaving the S.S.S.C. unit entirely unchanged, adding after it a mixer circuit, heterodyning the S.S.S.C. signal to the new output frequency. The circuit on the opposite page draws only about 30 ma. from a 250-volt power supply, and provides a maximum of about 180 volts R.F. signal output, which can be used for driving large or small Class A output stages, which, in turn, can drive a Class B high-powered stage. In other words, all the advantages of S.S.S.C. are achieved with a transmitter which contains only one high-powered output stage, and if a peak power of up to, say, 20 watts is considered enough output, then the whole transmitter will draw very little more power from its supplies than a 20-watt audio amplifier. At this, the output signal will have as much "punch" on the band as a conventional transmitter of some 80 watts carrier power. Considering communication effectiveness in terms of cost per watt of "equivalent" carrier, the S.S.S.C. transmitter wins hands down, in spite of the fact that it uses an impresssive array of Philips receiving tubes!

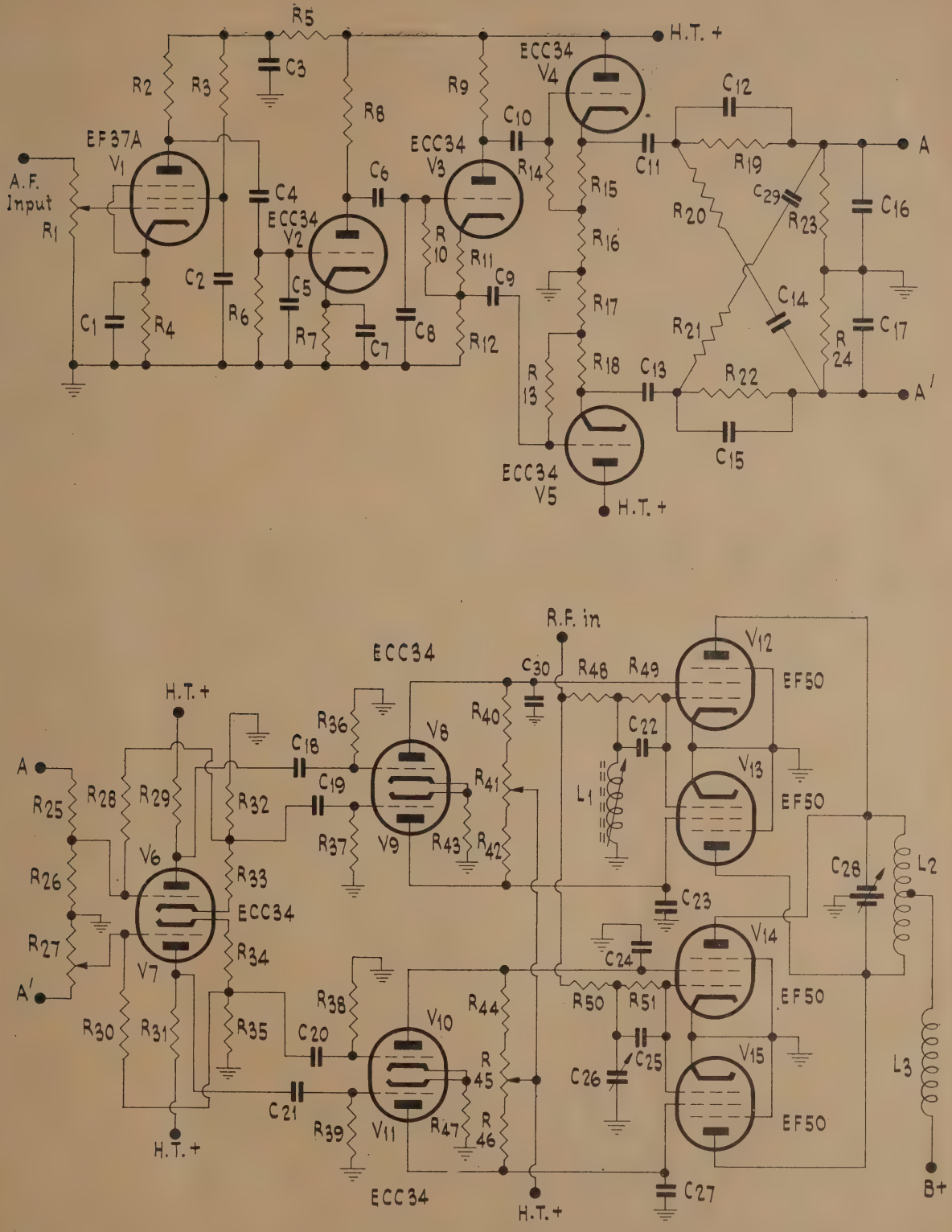
DESCRIPTION OF THE CIRCUIT

V_1 and V_2, Philips types EF37A and ECC34, are simply audio pre-amplifier stages, designed to bring the output of the microphone up to a level of some 20 volts at the grid of V_3. These stages are conventional except for the fact that the frequency response has been tampered with rather drastically. C_1 and C_7, the cathode bypass condensers have been made small in value so that there is a considerable loss of amplification at frequencies below 300 c/sec. Similarly, C_5 and C_8 have been added to reduce the response at high frequencies, so that the effective band-passs of these stages is from 300 to 3000 c/sec. In ordinary A.M. work, it has long been recommended that a response characteristic of this sort should be used, since the frequencies outside this range contribute practically nothing to intelligibility, but a great deal to the broadness of the signal. Many people have been very reluctant to do this, probably on account of the loss of naturalness about the speech, but it is a very good thing to do, both because it reduces QRM and also because with A.M. it enables a much higher effective modulation percentage to be used. With S.S.S.C., these advantages still hold, but there is an additional reason for limiting the frequency response. The wide-band phase-shift network that makes the phasing method practicable is designed to operate only between 300 and 3000 c/sec. That is to say, outside this frequency band, frequencies are no longer shifted in phase with the accuracy required for proper cancellation of the unwanted sideband, so that unless the audio input is limited to the range over which the phase shift network operates best, the unwanted sideband is produced whether we like it or not. But if the audio signal contains no frequencies outside the range of the network, then the partial undesired sideband cannot be produced anyway. This is the reason for the limitation of frequency response. It is possible to design phase-shift networks that work from 20 to 20,000 c/sec., but they are much more complicated than the one here, and anyway we do not want to lay on high-fidelity transmissions.

V_2 is one half of the Philips ECC34, the remaining half of which is used for V_3, a conventional phase inverter. This is needed because the phase-shift network requires two input voltages of 180° out of phase if it is to function properly. A further requirement is that the network should be fed from points of low impedance, so that because of this, the phase inverter is followed by another Philips ECC34, whose halves are cathode followers, fed from the outputs of V_3. Then comes the phase shift network itself, fed from the cathodes of V_4 and V_5 through blocking condensers. The network has two output terminals, A and A_1, from which the phase-shifted audio is taken, one for each balanced modulator.

As was pointed out in our discussion of balanced modulators, one possible arrangement for the inputs and the output connection, is to feed one input in parallel to the two grids, the other input in push-pull, and to take the output off in push-pull. It was not mentioned, however, that it is possible to use multi-grid tubes in a balanced modulator, so that one grid can be used for one signal and another for the remaining one, in each tube of the modulator. This has been done here by using Philips EF50s in the modulator circuits. The control grids are paralleled, and R.F. is fed to them. The screen-grids are used for feeding in the audio signal in push-pull, and the plates are connected in push-pull to a balanced output tank circuit. Now because of the requirement for push-pull audio input voltages for each balanced modulator circuit, each output from the phase-shift network is

(Continued on page 28.)


A.F. Input
R1
EF37A
V1
R2
R3
R5
C3
C4
R8
C6
ECC34
V2
C2
C5
R6
R7
C7
C1
R4
C8
ECC34
V3
R9
R10
R11
C9
R12
C10
R14
ECC34
V4
H.T. +
C11
R15
R16
R17
R18
C13
R13
ECC34
V5
H.T. +
C12
R19
A
C29
R20
R23
C16
C14
R21
R24
C17
R22
A'
C15
R.F. in
ECC34
V8
V9
C30
R48
R49
V12
EF50
C22
V13
EF50
L1
C28
L2
C23
V14
EF50
C24
R50
R51
C25
C26
V15
EF50
L3
B+
C27
H.T. +
R36
C18
C19
R37
R40
R41
R43
R42
A
R25
R28
R29
R32
V6
R26
R33
ECC34
R27
V7
R34
A'
R30
R31
R35
R38
C20
C21
R39
V10
V11
R44
R45
R47
R46
H.T. +
H.T. +
ECC34

Missing or Stolen Radios

The Police Department has supplied the New Zealand Radio Traders' Federation with the following list of missing or stolen radio sets. Should any member of the Federation or other reader have any knowledge of the present whereabouts of any of this radio equipment, he is asked to communicate with the nearest police station.

Police Station Masterton:

The undermentioned radios have been reported to the police in Masterton as stolen:

(1) Aladdin bedside radio—model 4B1—serial number S.N.21127, mottled grey metal case—stolen from display counter of W.F.C.A., Ltd., at Masterton on 22nd August, 1951.

(2) H.M.V. "Little Nipper" small mantle model, brown bakelite case, serial number 17990—5-valve, broadcast model. Stolen from Masterton, property of Cunningham Electrical Ltd., on 3rd September, 1951.

Police Station, Timaru:

Stolen at Timaru during the weekend 3rd-6th August, 1951. Description: Philips 4-valve broadcast model, in a black bakelite case or something similar, leather handle at one end, about 12 in. x 5 in., and when closed looks like a big folding camera, straight battery set (Mini-Max Eveready battery), the top is hinged and when up discloses the dial, number on radio is 4825. Valued at £8 15s.

Police Station, Marton:

Stolen from Turakina on 13th August, 1951. Portable radio "National" make, wooden case painted green, about 12 in. x 6 in. x 4 in., heavy brown leather carrying strap on top, bakelite tuning knob, volume control knob missing. Six-valve radio. Serial number of set not procurable. Identifiable.

Criminal Investigation Branch, Auckland:

A description of two missing radios which are forwarded for the information of members of your federation:—

(1) Pillaged from Austin A40 motor-car en route from London-Wellington-Auckland, ex the vessel *Rangitoto*—September, 1951—"Motorola" car radio, model 491, serial No. 14835, encased in pseudo-plastic material cream in colour, dial settings have English radio stations, two double control knobs in front, the outer one being plastic is for volume and station selection and the inner one being metal, is for changes in wave length; approximately 8 in. x 10 in. x 5 in. Identifiable.

(2) Missing from rail consignment between Auckland-Wellington on 5th September, 1951:

"Autocrat" motor-car radio, 8-valve, 12-volt consisting of two units, a speaker unit and a tuning unit. The tuning unit is a metal case, brown in colour with fleck effect. Serial No. 3487.

New Zealand Police, Invercargill:

John Frederick Noble, 390 Dee Street, Invercargill, radio stolen on 22nd September, 1951. The radio described below and which is the property of the above-named person was stolen from the Christchurch-Lyttelton express train at Invercargill on the evening of 22nd September, 1951.

"Philco" portable, model No. 350/A, serial number 16454, brown leatherette case, dial glass broken, and purchased from Chas. Begg and Co., Invercargill.

New Zealand Police, Christchurch:

The following described radio and amplifier have been reported stolen from St. Mark's School, Opawa, and

George Benson, Perce Wills,
Ray Walker, and the Staff of
Autocrat Radio Ltd.

extend the SEASON'S GREETINGS to all
friends and clients and assure them that 1952
will again be a successful year for

Autocrat Car Radios

AUTOCRAT RADIO LTD.

285 GREAT SOUTH ROAD (at The Harp o' Erin) AUCKLAND

Sole New Zealand Distributors: G. A. WOOLLER & CO., LTD., AUCKLAND.

Salvation Army Citadel, Christchurch, respectively:

"Austin" 4-valve broadcast radio, probably 1944 model, no chassis number inscribed.

"Joyrad" model amplifier, green metal box, approx. 2 ft. 6 in. x 12 in. The container is crackle finished; 3 microphone plugs; 3 speaker plugs, four dial.

Criminal Investigation Branch, Wellington:

1. Philips dual-wave radio; mantel model; in wooden cabinet; model No. 626; serial No. 31690. Stolen between 22nd August, 1951 and 31st August, 1951.

2. Philips table radiogram; model 699; serial No. 23270; incomplete state (minus cabinet, pickup and speaker). Stolen between 31st July 1951 and 31st August, 1951.

Wellington Central Police, Wellington:

The theft of one radio transmitter, stolen around the 14th August, 1951, in Wellington city. Radio transmitter, A.C. operated, 100-watt, bandswitching, self-contained C.W. or R.T. transmitter. Valued at approximately £75. Crystal number 3505.

Criminal Investigation Branch, Auckland:

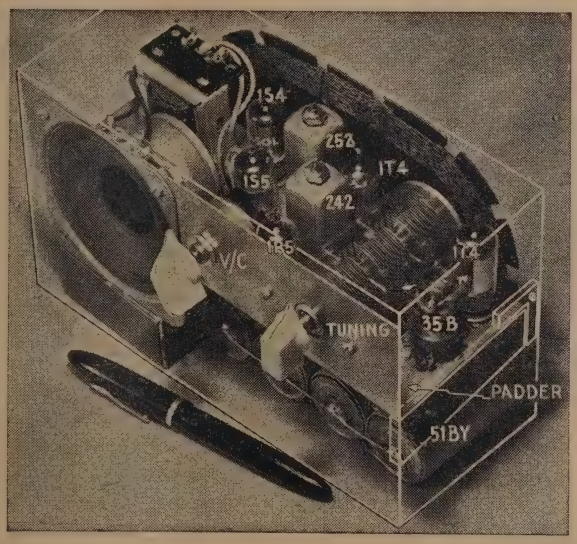
Stolen from a house at 3 Morton Street, Freeman's Bay, Auckland, between about 10 and 11 p.m. on 22nd September, 1951. Philips portable radio, dark red with cream facings, three control knobs, adapted for both A.C. and D.C., has been converted to use external batteries; model 545, serial No. 215. Identifiable by number and valued at £35.

Criminal Investigation Branch, Auckland:

Stolen from the shop of Bond and Bond, Ltd., 332A Ponsonby Road, Ponsonby, Auckland, between the 12th and 15th of October, 1951: "Skyscraper" personal portable radio, 6 valves, broadcast only A.C. and battery, serial No. 136312, size 9½ in. x 6 in. x 4½ in., white plastic cabinet, round dial at front, two white plastic tuning knobs, trade-mark between knobs, A.C./battery switch on back, white plastic handle at top, handle collapses flush with top of cabinet, fitted with Eveready battery No. C16, Eveready battery No. 467. Identifiable. Value, £25 6s. 3d.

New Zealand Police, District Office, Dunedin:

Radio set alleged stolen from hut at Waipori between 22/6/51 and 9/8/51, "Pacemaker Serial No. 66557. This has now been recovered by the police.



Your Xmas PORTABLE!

5-Valve Incorporating the Type

B-5 BASIC KIT

★ DIAMOND LOOP (gives greater efficiency)

★ CYLINDER IRON DUST CORE R.F. COIL (gives greater gain from the tuned R.F. stage)

★ HIGH-GAIN MIDGET I.F. TRANS.

★ FULL CIRCUIT SUPPLIED

★ ATTRACTIVE PLASTIC CABINET AVAILABLE

PORTABLE PERFORMANCE PLUS!

In good localities, during daylight hours, this Portable will receive all main New Zealand stations. At night, dozens of New Zealand and overseas stations can be received. This is really Portable Performance plus!

Order from our Stockist or Direct

IDEAL FOR PICNICS, SEASIDE BACHES, BOATING, Etc., Etc.

BASIC KIT includes Chassis, Gang, Coils, Loop, I.F. Transformer, Padder, Scale—£5 5s.

COMPLETE KIT, including Plastic Cabinet, less Valves and Batteries—£13 19s. 6d. (Limited number of Complete Kits available.)

Inductance Specialists

157 THORNDON QUAY - - WELLINGTON

(The New Zealand Radio Coil Specialists)

followed by a phase inverter, and, because a considerable audio voltage is required for connecting to the screens of the EF50s, a push-pull amplifier stage is used between each phase inverter and its own balanced modulator.

V_6 and V_7 comprise another ECC34, while two more ECC34s are used for the push-pull amplifier stages.

CONTROLS AND THEIR PURPOSES

In the top portion of the diagram there is only one control, namely the volume control, R_1, at the input of the audio section. It should be remembered, however, that in an S.S.S.C. transmitter, there is no output at all when there is no input to the speech amplifier, and that the "volume control" acts as much as an output power control. In fact, that is just what it is. The audio circuits are arranged so that they will not overload until well after the balanced modulators are overloaded, and if the subsequent stages are arranged so that none of them overload before the balanced modulators, then operating the whole transmitter, once set up, amounts to no more than turning up R_1 until the output stage is delivering its maximum undistorted power output. R_1, then, is the only "working" control, apart from the R.F. tuning knobs.

No more controls appear until the signal reaches the push-pull amplifiers, V_8 and V_9, and V_{10} and V_{11}. Here it will be seen that the plates of these valves are directly connected to the screens of the EF50s. This is the simplest and easiest way of providing the D.C. screen voltage for the modulator tubes, and at the same time gives a very satisfactory method for balancing the modulators. When we talk about balanced modulators, we are really referring to a figment of the imagination, since it is only in theory that a circuit is exactly balanced. For instance, unless the pair of tubes used in each modulator circuit are identical, and unless the component parts of each side of the symmetrical circuit are exactly equal, then the result will not be perfectly balanced modulation. In practice, we have to accept this situation, with the reservation that it is possible to provide adjustments which will make any unbalances as small as possible.

The main sources of unbalance are (a) unequal A.F. voltages to the halves of the modulator and (b) unequal mutual conductance in the modulator tubes themselves. The first point is looked after pretty well by using a type of phase inverter which gives a very well-balanced pair of output voltages, and, since triode amplifier stages are used, differences in stage gain between the two halves of the push-pull amplifier will be very slight. In this respect, the triode is fairly uncritical as to the exact equality of the load resistors. With the pentodes, however, small differences in mutual conductance will have noticeable effects on the balance, and a very simple way of balancing the gains is to place a differential control on the screen voltages. This has been done by inserting potentiometers R_{41} and R_{45}. These change differentially the screen voltages of the EF50s, thus altering their respective gains, while having almost no observable effect on the audio voltages, even though the potentiometers are part of the audio load resistance for the amplifier valve.

(To be continued.)

CRESSALL

ASBESTOS - WIRE - WOVEN RESISTANCE NETS

COST SO LITTLE
and
HELP SO MUCH

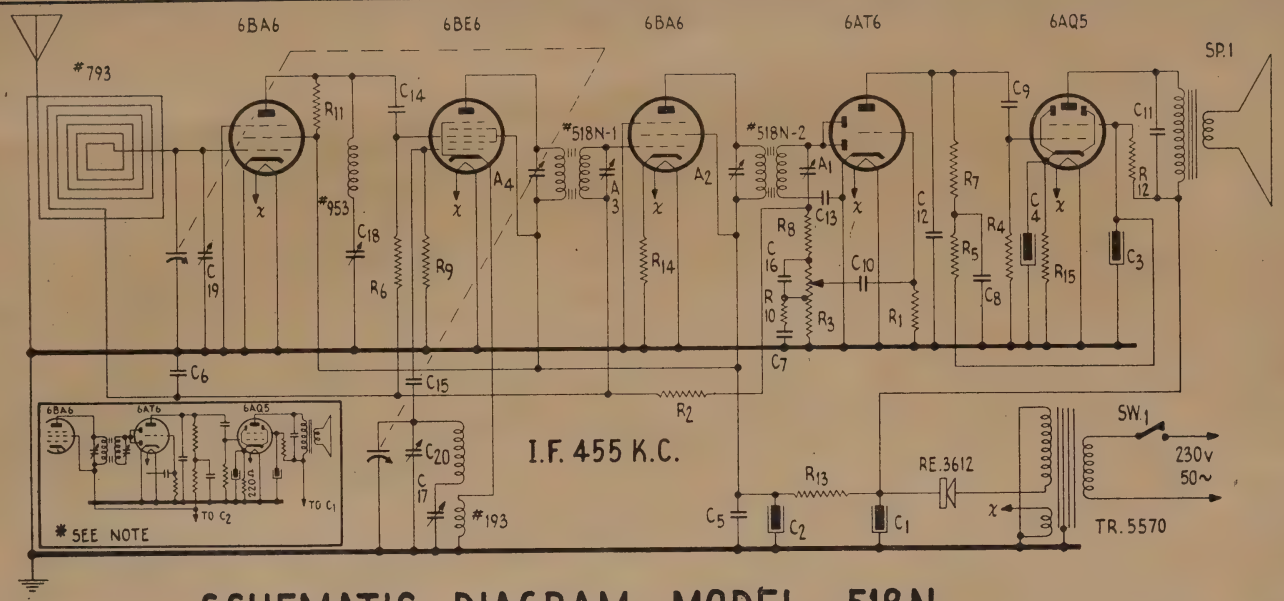
Limited number of 4-watt, 6-watt, 50-watt, and 100-watt types available ex stock.

From

Bradley's Electrical Co. Ltd.
57 VICTORIA STREET, WELLINGTON

New Zealand Distributors for
The Cressall Manufacturing Co., Ltd.,
Birmingham, England

FOR THE SERVICEMAN—The Gulbransen Model 518N



SCHEMATIC DIAGRAM MODEL 518N

VOLTAGE READINGS

Use	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
R.F.	6BA6	0	0	0	6.3 a.c.	70	94	0	
Conv.	6BE6	—5.5	0	0	6.3 a.c.	85	94	0	
I.F.	6BA6	0	0	0	6.3 a.c.	85	94	3	
Det-AF.	6AT6	0	0	0	6.3 a.c.	0	0	58	
Output	6AQ5	0	6.75	0	6.3 a.c.	113	113	0	

RESISTANCE READINGS

Use	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
R.F.	6BA6	2.5 meg	0	0	0	250 K	250 K	0	
Conv.	6BE6	20 K	.6 ohm	0	0	250 K	250 K	2.6 meg	
I.F.	6BA6	2.5 meg	0	0	0	250 K	250 K	600 ohm	
Det-AF.	6AT6	10 meg	0	0	0	.55 meg	.55 meg	400 K	
Output	6AQ5	.5 meg	500 ohm	0	0	250 K	255 K	.5 meg	

1. D.C. voltage measurements are at 2,000 ohm per volt—A.C. voltage measurements at 1,000 ohm per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Nominal Tolerance on component value make possible a variation of ± 10% in voltage and resistance readings.
5. Volume control at maximum, no signal applied for voltage measurements.
6. Resistance readings in B+ circuits may vary widely according to condition of filter capacitors.

Proceedings of the New Zealand Electronics Institute (Inc.)

Headquarters News

As we go to press, arrangements are in train to have the next meeting of Council in Christchurch. This will be held on 24th November and a full report will be available to members in the next issue of all businesss transacted.

Outstanding Subscriptions ...

As a result of the publication in these Proceedings of an appeal to members who have not yet paid their subscriptions, several amounts have been received but there are still a few members who have overlooked payment. The delivery of *Radio and Electronics* to these members has now of necessity been deferred pending their becoming financial again.

New System of Dispatch of "Radio and Electronics"

In order to speed deliveries of *Radio and Electronics* to our members, arrangements have now been completed with the printers for copies to be dispatched direct from there, hence there should be very little delay in future in receipt of these Proceedings.

Auckland Branch

Several applications for membership have been received from members resident in Auckland district and arrangements are being made to interest a small but active group in getting local meetings regularly held.

Christchurch Branch

There has been much activity in Christchurch recently and a meeting was held at 7.30 p.m. on Monday 29th October which took the form of a visit to the P. & T. Department Carrier Room in Hereford Street, where Mr. L. J. Fussell explained and demonstrated the equipment. A further branch meeting has been arranged for Monday, 26th November, and a full report of this meeting will appear in the next Proceedings.

Dunedin Branch

There has been considerable activity in Dunedin Branch of late but space does not permit full publicity regarding this branch at the moment.

Rutherford Appeal

Since the appearance of the November issue of *Radio and Electronics* much progress has been made in connection with the Rutherford Memorial Fund Appeal. The target in Canterbury is £5,000 and a Nelson organization is under way with a target of £2,000. Committees are being set up also in Dunedin and Auckland and it therefore appears that this project is well under way. Many organizations in Wellington have undertaken to assist and a full publicity programme is nnow proceeding covering radio talks, press releases, circulars, and the publication of material in *Radio and Electronics*.

Wellington Branch

Wellington Branch has been busy of late and a full programme of lectures and talks has been made for the entire year up to 12th June, 1952. This programme is reproduced below:

13th December, 1951—Short Papers and Discussion Night.

17th January, 1952—Mr. D. Ironside: "Pick-up Equalizers."

14th February, 1952—Dr. E. J. Robertson, Ph.D.: "Magnetometric Survey."

13th March, 1952—Reserved.
10th April, 1952—Reserved.
8th May, 1952—Social night.
12th June, 1952—Branch Annual General Meeting.

The latest Wellington branch meeting was held on 13th November, when Mr. R. Glassey, of the Civil Aviation Branch, Air Department, delivered a most interesting address on super-regenerative receivers. Mr. Glassey outlined the main types of super-regenerative circuit, namely separately-quenched and self-quenched, and described their action in the linear and logarithmic modes. By means of waveforms, the basic mechanism of these receivers was very clearly explained, together with such interesting matters as the reason for the strong inherent A.V.C. action of the logarithmic mode, whether self- or separately-quenched, and the effects of altering the quench frequency and amplitude. The speaker pointed out that the difficulties of accurate analysis of the performance of these circuits were such that in practice the design of super-regenerative receivers was still largely a matter of "cut and try."

At this meeting, a tape recording was taken of the whole lecture, and of the lively and interesting discussion that followed. The committee is expected to pronounce upon the success and usefulness of this scheme at the next meeting.

Underwater Television

In a recent statement issued by the Admiralty it was described how television equipment had been adapted for use under the sea and how it had been used in the identification of the lost submarine *Affray*.

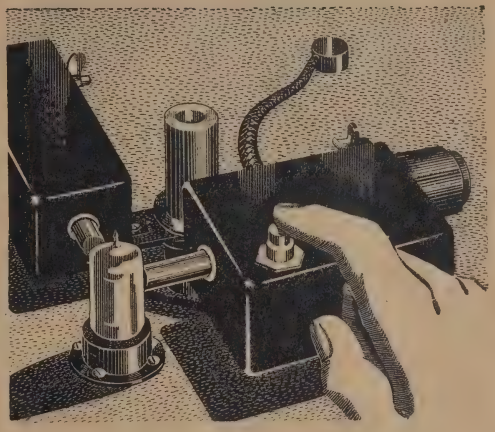
In connection with the development of this unique apparatus—the further use of which has infinite possibilities—British Insulated Callender's Cables Ltd., received a request from the Admiralty to solve the urgent problem of producing a television camera cable to meet the particularly arduous conditions.

The required cable was produced and supplied within a matter of a few days. Its design is very similar to the Company's 32-core type extensively used for B.B.C. broadcasts, but it was provided with an additional special protective sheathing making it suitable for use many fathoms under the sea. It was possible, therefore, to link the camera (258 feet under the sea) with the control equipment aboard the salvage vessel by a single cable capable of dealing with video signals, scan currents, power supply and, in fact, all the necessary circuits.

WHAT "Reception-Tested" REALLY MEANS

Before they are carton-sealed, every Brimar Valve has passed with full marks 10 rigid and exacting factory tests—static, vibratory, dynamic, followed by heat treatment, and finally "noise and gain" examination in a test circuit.

Test illustrated here shows valves undergoing vibration tests. Hammers strike the valves alternately from directions at right-angles, whilst meters record the effect on valve characteristics. This ensures that each Brimar Valve will give long and continuous satisfaction under the most arduous conditions . . . perfect radio performance.



Some of the valve types available here in New Zealand are:

	R.F. Tubes	Mixer Tubes	I.F. Tubes	2nd Detector	Output Tubes	Rectifier Tubes
1.4v. Battery Types	1T4	1R5	1T4	1U5	3V4	—
6.3v. Loctal Types	7H7	7S7	7H7	7K7	7C5	7Z4
6.3v. Octal Types	6K7GT	6K8GT	6K7GT	6B8GT	6V6GT	5Y3GT
6.3v. All-Glass Types	6BA6	6BE6	6BA6	6AT6	6AQ5	6X4

PROTECT YOUR CUSTOMERS . . .
PROTECT YOUR GOODWILL . . .
STOCK AND RECOMMEND

BRIMAR

BRITISH RADIO VALVES

"RECEPTION-TESTED" for your protection!

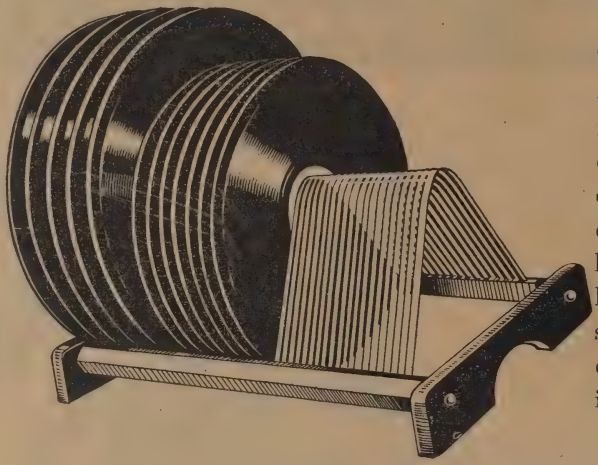
STANDARD TELEPHONES & CABLES PTY. LTD.

AN STC PRODUCT

WELLINGTON - - - - - Box 593
WANGANUI - - - - - - Box 293
CHRISTCHURCH - - - - Box 983
AUCKLAND - - - - - Box 571

Ask your Brimar Representative for new display material.

"PLATTERRACK" Record Storage Rack



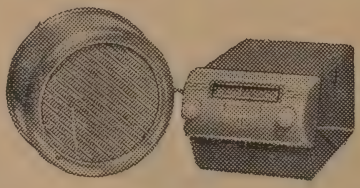
The ideal Record Storage Rack for up to 50 records, 10 in. or 12 in. Each division is individually numbered, and every record can be found at a glance. Numbered Index-cards and Label-stickers are supplied with each "PLATTERRACK". The records are held in place in the "PLATTERRACK" between velvety, rayon covered, resilient steel wires, and the records rest on silk cording. Plastic dust-covers are available if required.

Sole New Zealand Agents:

THE GROVER ELECTRICAL CO., LTD.

BOX 6192, WELLINGTON Branches at AUCKLAND, CHRISTCHURCH, PALMERSTON NORTH

KITSETS for PLEASURE and PROFIT



CAR RADIO KITSET

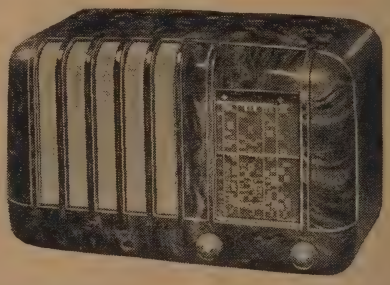
THIS 6-VALVE KITSET IS REMARKABLE VALUE AT £16/17/6 COMPLETE

FEATURES: 6-inch P.M. SPEAKER
PHILIPS RIMLOCK VALVES
COMPACT and available for 6 or 12-volt Systems

NEW 5-VALVE BROADCAST KITSET

WE NOW OFFER A RE-DESIGNED VERSION OF OUR WELL-KNOWN PLASTIC-CASED BROADCAST KIT

FEATURES: 5 PHILIPS RIMLOCK TUBES
6-inch SPEAKER
HIGH-GAIN I.F.s
PROFESSIONAL APPEARANCE
COMPLETE FOR ONLY £14/10/-



WEBB'S RADIOS LTD.

10 WELLESLEY STREET E.
AUCKLAND

TUBE DATA: The 809 R.F. Power Amplifier, Class B Modulator

The 809 is a high-mu transmitting tube with a typical power output of 75 watts (ICAS) for class C telegraph service. Because of its high perveance, the tube can be operated at high plate efficiency with low driving power and low plate voltage. Grid bias requirements of the 809 in Class B A.F. service are extremely low. The internal structure of the 809 permits operation of the tube at maximum ratings at frequencies as high as 60 megacycles.

DUAL RATINGS

The new system of dual ratings consists of two sets of maximum ratings for each class of service. These ratings are designated Continuous Commercial Service (CCS) and Intermittent Commercial and Amateur Service (ICAS).. CCS ratings are essentially equivalent to former maximum ratings and are based on long tube life and maximum reliability of service. ICAS ratings permit the use of much greater power input and provide relatively greater useful power output. Tube life under ICAS conditions, of course, is reduced. In the many applications where minimum size, light weight, low initial cost, and maximum power output are more important than extremely long tube life, a small tube operated under ICAS ratings may be more desirable than a larger tube under CCS ratings. The new system of ratings recognizes these diversified requirements. The choice of tube operation conditions best suited for a particular application should be based on careful consideration of all factors.

CHARACTERISTICS AND RATINGS

Filament voltage (A.C. or D.C.)	6.3	volts
Filament current	2.5	amp.
Amplication Factor	50	
Direct interelectrode capacitances:		
Grid-plate	6.7	*uuf.*
Grid-filament	5.7	*uuf.*
Plate-filament	0.9	*uuf.*
Bulb	ST-19	
Cap	Medium Metal	
Base	Medium 4-pin "Micanol," Bayonet	

MAXIMUM CCS AND ICAS RATINGS WITH TYPICAL OPERATING CONDITIONS

CCS = Continuous Commercial Service
ICAS = Intermittent Commercial and Amateur Service

As A.F. Power Amplifier and Modulator—Class B

	CCS	*ICAS*	
D.C. plate voltage	750 max.	1000 max.	volts
Max. signal D.C. plate current*	100 max.	100 max.	ma.
Max.-signal plate input*	75 max.	100 max.	watts
Plate dissipation	25 max.	30 max.	watts

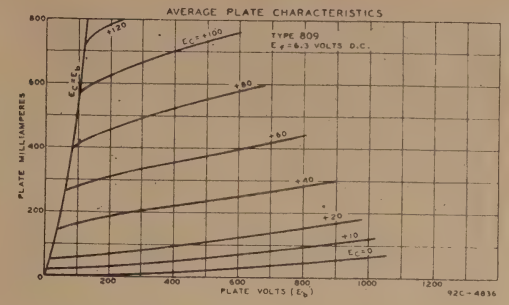
Typical operation:

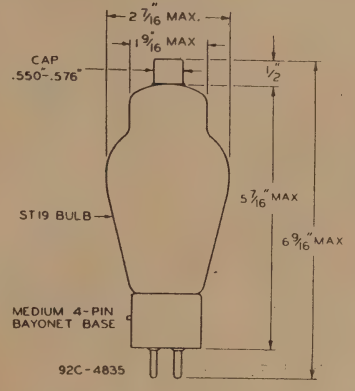
Unless otherwise specified, values are for 2 tubes

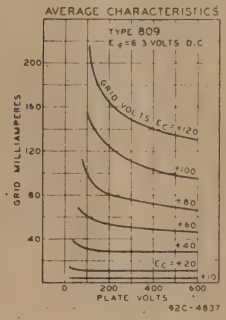
D.C. plate voltage	500	750	1000	volts
D.C. grid voltage†	0	—4.5	—10	volts
Peak A.F. grid-to-grid voltage	135	140	156	volts
Zero-sig. D.C. plate current	40	40	40	ma.
Max.-sig. D.C. plate current	200	200	200	ma.
Load resistance (per tube)	1300	2100	2900	ohms
Effective load resistance (plate-to-plate)	5200	8400	11600	ohms
Max.-sig. driving power (approx.)	2.4	2.4	3.4	watts
Max.-sig. power output (approx.)	60	100	145	watts

As Plate-Modulated R.F. Power Amplifier—Class C Telephony
Carrier conditions per tube for use with a maximum modulation factor of 1.0.

	CCS	*ICAS*	
D.C. plate voltage	600 max.	750 max.	volts
D.C. grid voltage	—200 max.	—200 max.	volts
D.C. plate current	83 max.	100 max.	ma.
D.C. grid current	35 max.	35 max.	ma.







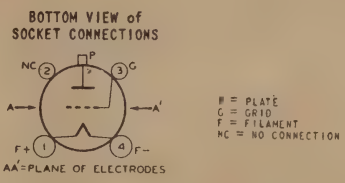


Plate input	50 max.	75 max.	watts
Plate dissipation	17.5 max.	25 max.	watts

Typical operation:

D.C. plate voltage	500	600	750	volts
D.C. grid voltage of	—60	—60	—60	volts
From a grid resistor of	2000	2000	2000	ohms
Peak R.F. grid voltage	135	135	150	volts
D.C. plate current	83	83	100	ma.
D.C. grid current (approx.)‡	32	32	32	ma.
Driving power (approx.)	3.2	3.2	4.3	watts
Power output (approx.)	30	38	55	watts

As R.F. Power Amplifier and Oscillator—Class C Telegraphy
Key-down conditions per tube without modulation§

	CCS	*ICAS*	
D.C. plate voltage	750 max.	1000 max.	volts
D.C. grid voltage	—200 max.	—200 max.	volts
D.C. plate current	100 max.	100 max.	ma.
D.C. grid current	35 max.	35 max.	ma.
Plate input	75 max.	100 max.	watts
Plate dissipation	25 max.	30 max.	watts

Typical operation:

D.C. plate voltage	500	750	1000	volts
D.C. grid voltage of	—50	—60	—75	volts
From a grid resistor of	2500	3000	3000	ohms
From a cathode resistor of	420	500	600	ohms
Peak R.F. grid voltage	135	140	160	volts
D.C. plate current	100	100	100	ma.
D.C. grid current (approx.)‡	20	20	25	ma.
Driving power (approx.)‡	2.5	2.5	3.8	watts
Power output (approx.)	35	55	75	watts

*Averaged over any audio frequency cycle of sine-wave form.

†Grid voltages are given with respect to the midpoint of filament operated on A.C. If D.C. is used, each stated value of grid voltage should be decreased by one-half the filament voltage and the circuit returns made to the negative end of the filament.

‡Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should be capable of delivering considerably more than the required driving power.

§Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent. of the carrier conditions.

INSTALLATION

The base of the 809 fits the standard 4-contact socket, such as the RCA type UR-542A. The socket should be installed to hold the tube in a vertical position, base down. If it is necessary to place the tube in a horizontal position, the socket should be mounted with the filament-pin openings one vertically above the other so that the plate will be in a vertical plane (on edge). The plate connection is made to the cap at the top of the bulb.

The bulb becomes very hot during continuous operation. Free circulation of air, therefore, should be provided. The installation of all wires and connections should be made so that they will not be close to or touch the bulb in order to avoid puncture of the glass.

The filament voltage should not vary more than ±5 per cent. from the rated value; otherwise, a loss of filament emission may result. It is recommended that, in intermittent service where the average number of daily transmissions is greater than 100, the filament be maintained at 80 per cent. of normal voltage during standby periods. If the number of transmissions is less than 100 per day, the filament power should be removed during standby periods.

The plate of the 809 shows no colour at the maximum plate-dissipation rating for each service.

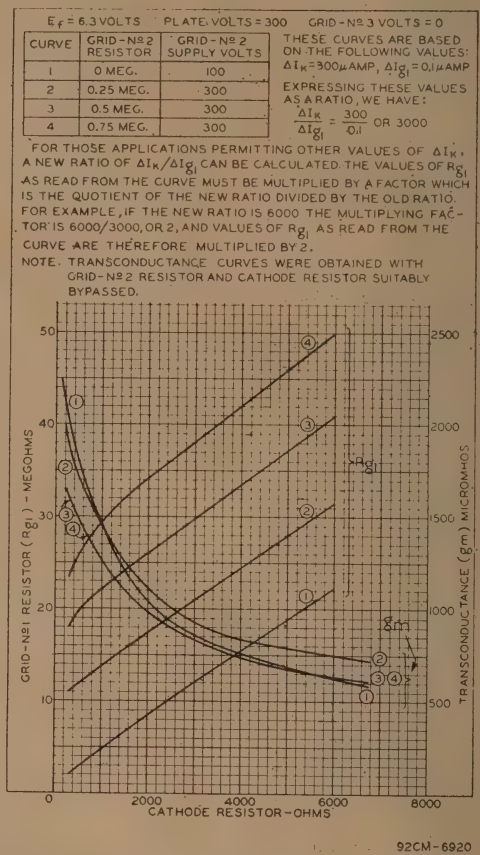
Overheating of the 809 by severe overload may decrease its filament emission. The filament activity can sometimes be restored by operating the filament at rated voltage for ten minutes or more with no voltage on the plate or grid. This process may be accelerated by raising the filament voltage to 7.5 volts (not higher) for a few minutes. The positive high-voltage supply lead should be provided with a protective device, such as a high-voltage fuse. This device should instantly remove the plate voltage when the D.C. plate current reaches a value of 50 per cent. greater than normal.

In order that the maximum ratings given under Maximum Ratings and Typical Operating Conditions will not be exceeded, changes in plate and filament voltages due to line-voltage fluctuation, load variation, and manufacturing variation of the associated apparatus, must be determined. An average value of plate and filament voltage should be chosen so that under the usual voltage variations the maximum rated voltage will not be exceeded.

When a new circuit is tried or when adjustments are made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect. It is advisable to use a protective resistance of about 3000 ohms in series with the plate lead during such adjustment. *The rated plate voltage of this tube is high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially when the exposed circuit parts are at high D.C. plate potential.*

APPLICATION

In *class B modulator or audio-frequency service,* two 809's are used in a balanced circuit, each tube amplifying half the time. The input transformer should be designed


Ef = 6.3 VOLTS PLATE VOLTS = 300 GRID-№3 VOLTS = 0
CURVE | GRID-№2 RESISTOR | GRID-№2 SUPPLY VOLTS
1 | 0 MEG. | 100
2 | 0.25 MEG. | 300
3 | 0.5 MEG. | 300
4 | 0.75 MEG. | 300
THESE CURVES ARE BASED ON THE FOLLOWING VALUES: ΔIK=300μAMP, ΔIg1=0.1μAMP
EXPRESSING THESE VALUES AS A RATIO, WE HAVE: ΔIK/ΔIg1 = 300/0.1 OR 3000
FOR THOSE APPLICATIONS PERMITTING OTHER VALUES OF ΔIK, A NEW RATIO OF ΔIK/ΔIg1 CAN BE CALCULATED. THE VALUES OF Rg1 AS READ FROM THE CURVE MUST BE MULTIPLIED BY A FACTOR WHICH IS THE QUOTIENT OF THE NEW RATIO DIVIDED BY THE OLD RATIO. FOR EXAMPLE, IF THE NEW RATIO IS 6000 THE MULTIPLYING FACTOR IS 6000/3000, OR 2, AND VALUES OF Rg1 AS READ FROM THE CURVE ARE THEREFORE MULTIPLIED BY 2.
NOTE. TRANSCONDUCTANCE CURVES WERE OBTAINED WITH GRID-№2 RESISTOR AND CATHODE RESISTOR SUITABLY BYPASSED.
GRID-№1 RESISTOR (Rg1) - MEGOHMS
TRANSCONDUCTANCE (gm) MICROMHOS
CATHODE RESISTOR-OHMS
Rg1
gm
92CM-6920

Operation Characteristics of Type 5693.

to give good frequency response when operated into an open circuit, such as that represented by the grid circuit of the class B stage when the signal amplitude is small. It should also be designed so that the resistance load presented by the modulated class C amplifier is reflected as the recommended plate-to-plate load in the class B A.F. stage. Grid bias should be obtained from a battery or other D.C. source of good regulation. It should not be obtained from a high-resistance supply such as a grid leak or a cathode-bias resistor. When the 809 is operated at a plate voltage of 500 volts or less, the tube may be operated with zero bias.

In *plate modulated class C R.F. service,* the 809 may be supplied with grid bias from a grid leak, or from a suitable combination of either grid leak and fixed supply, or a grid leak and cathode resistor. The cathode resistor should be suitably by-passed for audio and radio frequencies. The combination-bias method of grid leak and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also minimizes distortion effects by bias-supply compensation. Grid-bias voltage for class C service is not particularly critical so that correct adjustment may be obtained with values differing widely from those indicated for this service.

In *class C R.F. telegraph service,* the 809 may be supplied with grid bias by any convenient method. When the

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The NATIONAL ELECTRICAL AND ENGINEERING CO. LTD.

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809 is operated, under the maximum ICAS conditions, in the final amplifier or a preceding stage of a transmitter designed for break-in operation and oscillator keying, a small amount of fixed bias must be used to maintain the plate current at a safe value. With plate voltage at 1000 volts, a fixed bias of at least —10 volts should be used.

The 809 may be operated at maximum ratings in all classes of service at frequencies as high as 60 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised (other maximum ratings are the same as shown under Characteristics). The tabulation below shows the highest percentage of maximum plate voltage and power input that can be used up to 120 mc/sec.

Max. permissible percentage of maximum rated plate voltage and plate input:

Frequency (mc/sec.)	60	70	120
Class B R.F.	100%	93%	75%
Class C plate-mod.	100%	88%	50%
Class C telegraphy	100%	88%	50%

When more R.F. power output is required than can be obtained from a single 809, the push-pull or the parallel connection may be used. For example, two tubes connected in push-pull or in parallel will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage; the push-pull connection requires twice the R.F. excitation necessary to drive a single tube. With either connection, the driving power required is approximately twice that for single-tube operation while grid bias is the same as that for a single tube. The push-pull arrangement has the advantage of simplifying the balancing of high-frequency circuits and of cancelling the even-order harmonics from the output.

If parasitic oscillations occur in the parallel or the push-pull circuits, they can often be eliminated by connecting a non-inductive resistor of 10-100 ohms in series with each grid lead, as close to the socket terminal as possible.

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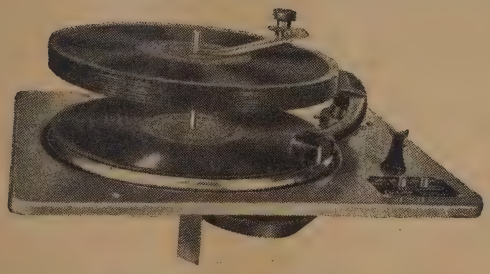
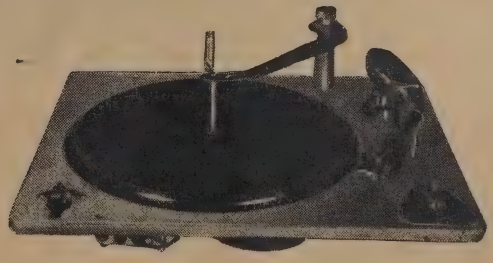


The Collaro RC500
Record Changer

A brilliant automatic record changer, specifically designed for simplicity and reliability. Plays nine 10 in. or nine 12 in. records. Incorporates spring suspension, which eliminates acoustic feedback. And it's foolproof against jamming.

Available with a choice of pick-up including magnetic, crystal, and high-fidelity models. Both models suitable for A.C. supplies only.



The Collaro 3RC511
Record Changer

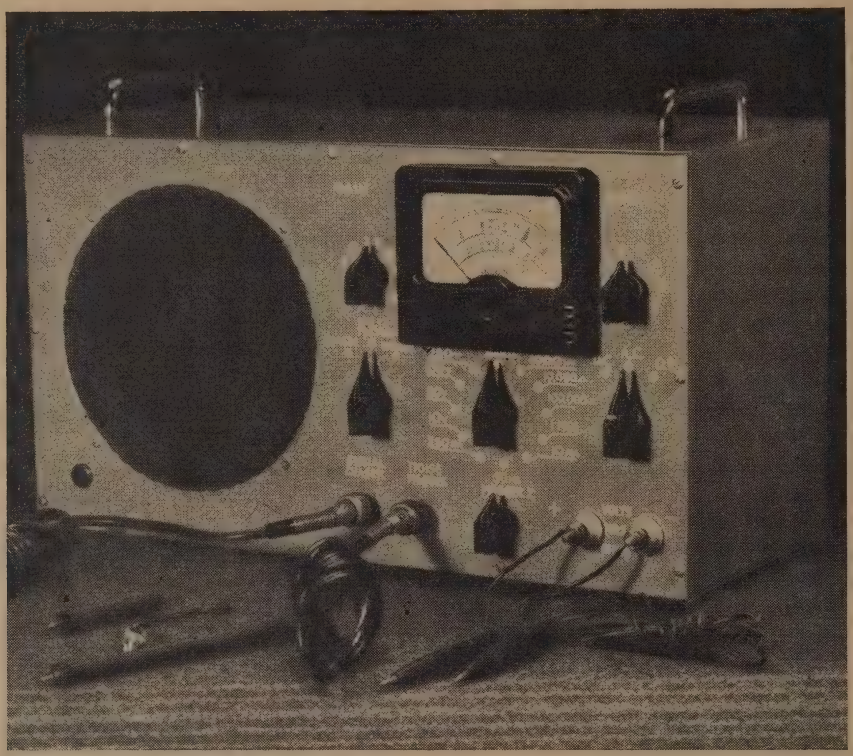
A completely automatic three-speed changer designed to "take all records"! 3RC511 plays 33⅓, 45, and 78 r.p.m. records with a minimum need for adjustments. Fitted with pick-up arm, suitable for all types of Collaro plug-in heads. Beautifully made and completely foolproof.

Sole New Zealand Distributors:

RUSSELL IMPORT CO., LTD. WELLINGTON

A Flexible Test Instrument—Part II (Conclusion)

By C. D. COOK



In the amplifier, negative feedback has been avoided because when using the chaser all forms of correction must detract from a faithful recognition of the state of affairs in the equipment under test. The only apparent concession to "doctoring" is the 100 pf condenser from the 6SN7GT input grid to earth, and this is included only to minimize the generation of parasitics occasioned by connecting the probes to the other equipment.

The bezel, to the lower left of the speaker ,indicates when the mains voltage is switched on.

The signal chaser input and the noise and megger input terminals are both single-contact microphone connectors, and the test prod terminals for the multitester are porcelain straight-through insulators.

The University test prods are red and black and connect to the straight-through insulators by means of four-foot red and black leads of No. 148 P.V.C.

Housing the instrument, the case is of 20-gauge tinned steel, the ends being $\frac{3}{8}$ in. flanged all round and sweated into the top, back, and bottom which are all one piece. The front edge of the top is also $\frac{3}{8}$ in. flanged.

The panel mounts flat on the front of the chassis, being separated from it only by two strips of Selotape running full chassis-length to prevent rattle, and is held in position by the mounting of the micro-phone connecters, the megger zero control, the straight-through insulators, and also by three Parker-Kalon screws along the bottom edge.

The speaker grille is two squares of $\frac{1}{8}$ in. wire mesh with a piece of speaker grille-cloth between them, all clamped in place by the speaker which is held to the panel by four $\frac{1}{8}$ x $\frac{1}{4}$ in. brass machine screws. The mesh visible from the front protects the speaker-cone, the cloth keeps out dust, and the second mesh prevents the tendency of the cloth to flutter against the front mesh and cause extraneous sounds when the speaker is working at some volume. The same technique is employed in the back wall of the case, to cover the eight holes for the release of back pressure from the cone.

The chassis slides into the case and is rigidly held there by fourteen P.K. screws from the bottom, and by 9 P.K. screws through the panel.

The chromium handles on top and the four rubber feet underneath the bottom corners, all machine-screwed on, are obtainable from any hardware store.

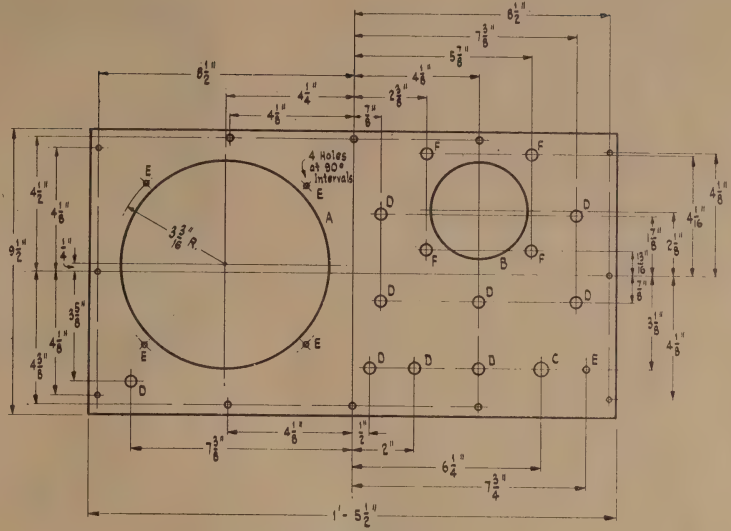
The probe which is used for noise location and for the megger is made quite simply as follows:—

Slide a 6 in. length of thin-walled good quality $\frac{3}{8}$ in. coil former on to a four-foot length of single microphone cable, so that the cable protrudes from both ends of the former. Clean off one inch of the outside plastic covering and also the same amount of shielding braid. Clean off half-inch of the inside plastic insulation. Tin the half-inch protruding end of the exposed internal conductor. Cut off the pin of an obsolete Philips banana plug, thus exposing the hole inside the base of the pin. (These

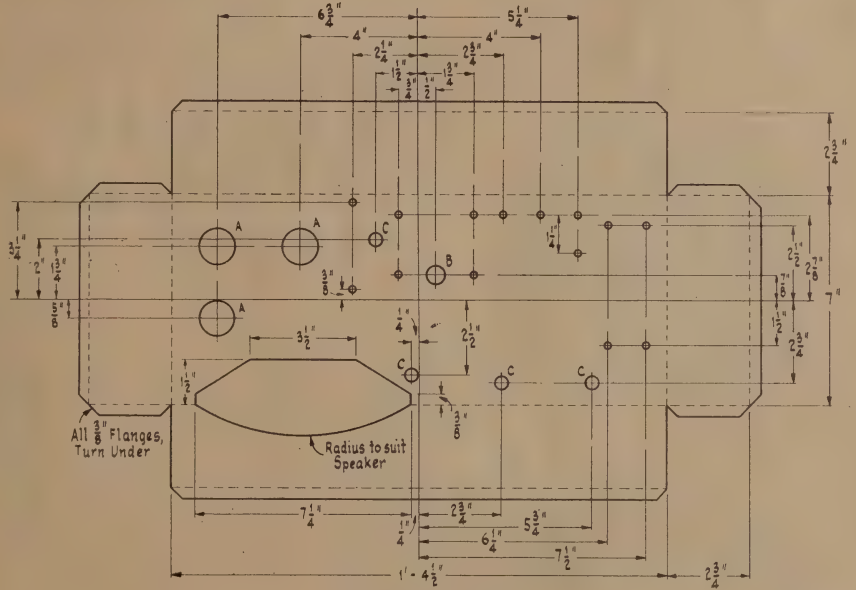
plugs were much used with the old Philips 180-volt "B" battery eliminator.) Slack off the grub screw in the plug. Insert the tinned conductor in the hole in the usual method of banana plug connection, pushing the plug on to the cable as far as the insulation will allow. Push the former along the cable until it is forced over the bakelite portion of the plug. File at flat near the blunt end of a talkie needle, insert this end into the hole in the metal of the plug so that the needle laps the tinned conductor, tighten the grub-screw, and trim off any surplus tinned conductor. Fit a single microphone connecter to the other end of the cable.

The return for the noise/megger probe is an eighteen inch lead of No. 148 P.V.C. terminating in a peewee clip. The other end of this lead is stripped $\frac{1}{8}$ in. and soldered to the shielding of the microphone cable through a $\frac{1}{8}$ in. hole in the external covering exactly at the back end of the former. For this an iron with a sharp point or a sharp corner must be used, and even then very carefully, since too much heat will soften the internal insulation of the cable, resulting in a dead short.

The chaser probe starts as a lug-strip on which are mounted one end of a 0.01 μf. condenser, both end of a 1N34 crystal diode (positive end connects to condenser), one end of a six-foot microphone cable stranded internal conductor, and the shielding braid after it has been cleaned back for $\frac{3}{4}$ in. all connected as shown in the diagram. A nine-inch length of $\frac{5}{8}$ in. shielding braid is slipped over the cable and the nearest end is soldered to the cable-shield earth lug. A $1\frac{1}{2}$ inch length of stranded hook-up wire connects an ordinary banana plug to the free end of the 0.01 μf. condenser. Next, from the far end of the cable, a $5\frac{1}{2}$ in. length of thin-walled good quality $\frac{5}{8}$ in. coil former is pushed right along, passed the braid, until the components on the strip are hidden.



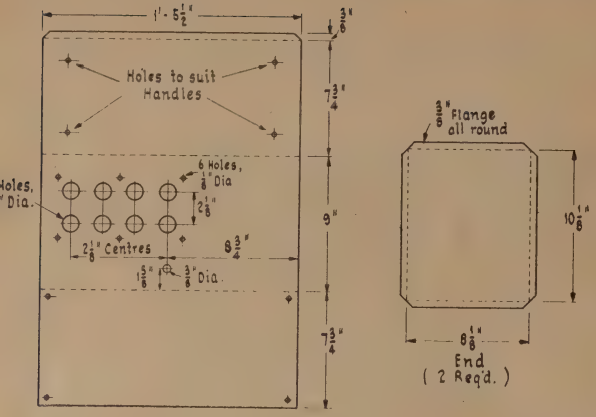
Drillings:
A = $7\frac{1}{8}$" Dia. B = $3\frac{1}{4}$" Dia. C = $\frac{1}{2}$" Dia.
D = $\frac{3}{8}$" Dia. E = $\frac{1}{8}$" Dia. F = To suit Meter



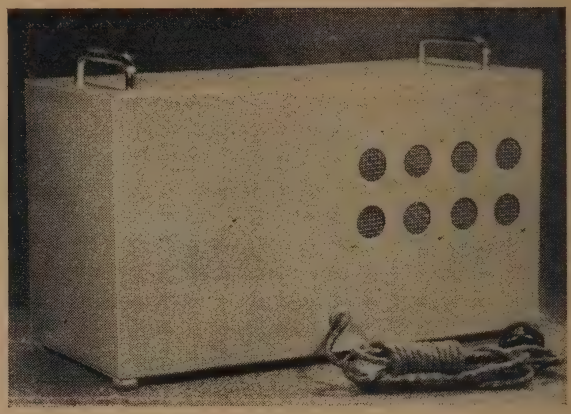
Drillings:
A = $1\frac{1}{8}$" Dia. B = $\frac{5}{8}$" Dia. C = $\frac{3}{8}$" Dia.

Chassis and Panel Drawings.

Then the body of the banana plug is painted with "Q" dope and wound with tape while still tacky until it can be forced into the end of the former which also is treated with tacky "Q" dope. After two hours of normal drying, the braiding is turned inside-out by pulling it



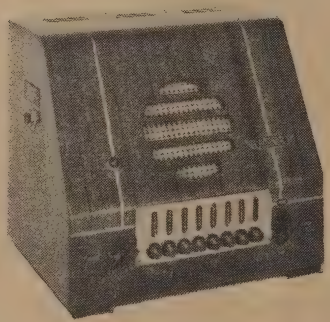
Tinned Steel Case



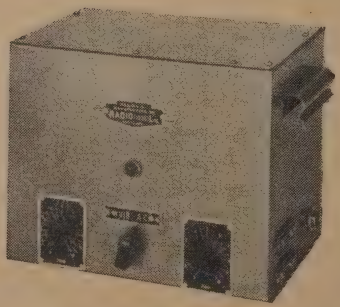
down over the former as tight as possible. Now the surplus braid is cut off so that it is at least an ⅛ in. shorter than the length of the former, and the end so formed is stuck lightly in position by a single turn of Selotape. The outside body of the proble is a 6 in. length of ¾ in. former, pushed as was the other one, from the far end of the cable until it forms a sheath over the probe. A cut down quart bottle cork is slotted lengthwise to take the cable, is "Q" doped all over, and is forced into the half-inch recess in the back end of the probe. A single microphone connecter is fitted on the far end of the cable, and the whole is ready for use.

The attenuator for use in certain applications with the above probe, is simply a 3 in. length of ½ in. former containing a 100 pf mica condenser connected between a banana plug and socket in either end of the former, held in by the same method as in the chaser probe. Owing to the reactance of this attenuator, when it is plugged on to the tip of the chaser probe, considerably less signal is passed, and the amplifier remains manageable when the output plate circuit of equipment is under test.

The original instrument case was painted a mid-blue while the panel was painted light blue, both colours covering a coat of priming paint. The white print on the panel is the work of a sign-writer.



8-*Station Intercom. Master Control*



5-*Watt Vibrator/A.C. Amplifier*

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- PRECISION ENGINEERED

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NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

NEW DESIGN "PANAMA" ELECTRIC JUG

Messrs. Cory-Wright & Salmon, Ltd., announce the release to the retail trade of a striking new design in "Panama" electric jugs.

Manufactured of heavy-gauge chromium-plated copper and fitted with both plastic base and handle, this jug will enhance any kitchen and can also be used at the table.

Additional features that merit attention include a specially designed lid which incorporates a vent, thus eliminating bubbling when the jug is boiling, and also the jug pours extremely well. The element is guaranteed for a period of two years.

The "Panama" electric jug will retail at £4 15s.

MORPHY-RICHARDS "POP-UP" TOASTER

The entry of "Pop-up" toasters into the New Zealand market has been welcomed by the trade because it means they are now able to offer the buying public the latest in such an appliance.

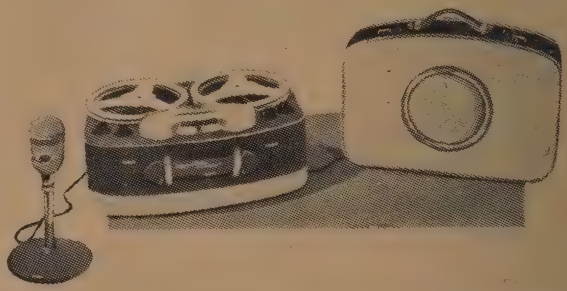
As one would expect, "Morphy-Richards," whose name has been associated with an automatic domestic

iron for some years, are to the forefront, and their most attractive toaster operated by bimetal timing unit, is a worthy partner to their iron.

Further particulars can be obtained from the sole New Zealand distributors, Russell Import Co., Ltd., P.O. Box 102, Wellington.

PHILIPS PORTABLE MAGNETIC-TAPE RECORDER, SEMI-PROFESSIONAL TYPE

This portable magnetic tape-recorder is invaluable for journalism (reporting interviews), teaching (important lectures, lessons in foreign languages), the-



atres (production of background effects, recording of performances), police (interrogations), industry (music for workers, staff education, recording of conferences and important meetings), medicine (psychology, laryngology), publicity (explanations during demonstrations), home movies, diction, singing, and music.

The quality of tape recordings made with this portable machine is superior to that of gramophone records. The tapes may be played back or stored almost indefinitely. The original sound can be reproduced immediately after recording, tapes can be edited, cut, and recombined to form a wide variety of information or programme, and whenever required can be erased and reused for new recordings.

The Philips tape recorder comprises two aluminium cases—one for the recorder and one housing the reproducer. A studio quality Philips microphone, with table stand, is part of the equipment, and an induction coil is also available for recording telephone conversations. The tape spools hold nearly 1700 ft. of tape, which gives about 45 minutes playing time. A full spool can be rewound in three minutes.

The construction of the Philips tape recorder is another example of Philips quality. Wide use has been made of precision ball-bearings, and the whole apparatus has been designed and constructed for long life and trouble-free service.

Philips Tape Recorder Type 3540/3545

Tape velocity, 7½ in./sec.

Recording and playback time for 1690 ft. of tape, 45 min.

Instantaneous speed variations (wow and flutter) less than 0.15 per cent.

Rewind time for 1690 ft. of tape, 3 min.

Rapid-winding time for 1690 ft. of tape, 3 min.

Input sensitivity for microphone, 1.7 mV.

Input sensitivity for pick-up or radio, 200 mV.

Input impedance for microphone, 100,000 ohms.
Input impedance for pick-up or radio, 50,000 ohms.
Output at the loudspeaker sockets, 6w.
Output voltage eat the line sockets, 1.5v.
Output impedance at the loudspeaker sockets, 5.5 ohms.
Output impedance at the line sockets, 500 ohms.
Frequency response curve, 60-8000 c/s ± 2 db.
Hum and noise level, — 50 db.
Distortion at an output of 6w., less than 5 per cent.
Distortion at an output of 1w., less than 1 per cent.
Bias and erase frequency, 45 kc/s.
Consumption, 85w.

"ULTIMATE" (RADIO (1936) LTD.) BROADCAST MANTEL MODEL "MUSGRAVE"

The illustration on this page is of a highly efficient and popularly priced model radio.

The new features listed here will give prospective purchasers some idea of the quality of the receiver.

High quality tonal reproduction comparable with that of a console radio is achieved by use of the new 6-9 elliptical speaker mounted on a full cabinet width baffle.

Minimized harmonic distortion is accomplished by use of special circuit inverse feedback.

An improved slide rule dial scale allows for easy tuning.

Only the two most used controls are placed on the front panel—one for tuning and the other for volume. The tone control is fitted on the left-hand side of the cabinet.

On performance and price, this is an outstanding model that should meet with instant approval and bridge the gap between the smaller bedroom set and the higher priced de luxe mantel models.

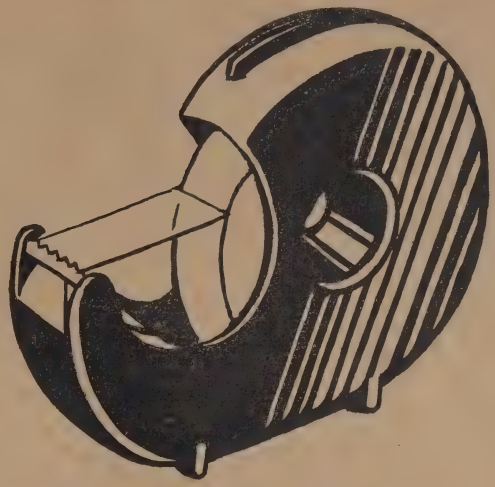
The cabinet is beautifully finished in straight-grained walnut veneer and the dimensions are: 16½ in. long, 12⅛in. high, 6⅝ in. deep.

Specifications:

Valves: 1 6X4, 1 6AQ5, 1 6AV6, 1 6AR7GT, 1 6BE6.
Mains consumption: 50 watts; output 3 watts.
Coverage: 550–1600 kc/sec.
Speaker: 6-9 elliptical.
Price: £27 19s. 3d. retail.

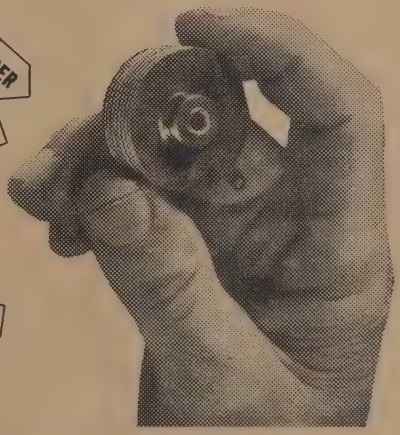
DUREX TAPE DISPENSER

Swan Electric Co. who have recently been appointed sole Radio and Electrical distributors for Durex Tape and Dispensers, announce the new plastic hand dispenser illustrated below, to take rolls up to ½ in. wide and 36 yards long. This is an excellent counter selling dispenser, attractively cartoned, and with approximately



half a million households in New Zealand, each a prospective buyer, radio and electrical dealers will find this a ready seller.

The list price of this dispenser is 3s. and there are attractive discounts for dealers purchasing quantities.

29 DIFFERENT RECTIFIER TUBES
Now Replaceable
with S.T.C. Miniature Radio Rectifiers
IT'S STRONGER
IT'S CHEAPER
LASTS LONGER
RUNS COOLER
SAVES SPACE

AN STC PRODUCT
Write 'phone or call the Sole N.Z. Agents
STANDARD TELEPHONES & CABLES PTY. LTD.
Wellington - - Box 593 Auckland - - Box 571
Christchurch - Box 983 Wanganui - - Box 293

TRADE WINDS

Holme Moss TV Mast

In featuring this on the front cover of the November issue we omitted to give credit to the designers. This mast is very similar to the one at Sutton Coldfield, both masts having been designed and erected to B.B.C. specifications by British Insulated Callender's Construction Co., Ltd., London, England. Constructional details of the Holme Moss mast are comprehensively illustrated and described in a pamphlet issued by the company and captioned "Top O 'T' Moss." Painter Bros. Ltd., Hereford, England, supplied the fabricated steel stay ropes. John Laing Son, Ltd., were sub-contractors for the foundations.

* * *

Green and Cooper Ltd. advise that Civil Air Board have placed with them an order for "Pye-Ericsson" Multiplex V.H.F. Link Equipment. The equipment will provide six voice-channels, an engineering channel, plus remote switching arrangements between Mt. Egmont, Colonial Knoll, Wellington, and Paraparaumu. Frequencies in the 150 to 170 mc/sec. band will be used. The contract runs into approximately £30,000.

Philips Electrical Industries of New Zealand, Ltd., announce that their Christchurch branch has removed to more commodious premises at No. 800, Colombo Street.

* * *

Mr. A. Fell, of London, who is a director of Pye (N.Z.), Ltd., has won the Yarmouth(Norfolk) seat for the Conservatives, from the Labour Party, in the recent general eelctions in Britain.

* * *

Mr. A. C. Day, London manager of Turnbull and Jones, Ltd., has been appointed general manager of the company in New Zealand. Before his appointment as London manager, Mr. Day was chief engineer at head office, Wellington. He is succeeded in London by Mr. Maitland Jones, of Wellington, until recently factory superintendent for the company in New Zealand.

* * *

Mr. Harold Boyd, of Radio (1936) Ltd., is going to the United States on the *Rawhiti* as wireless operator.

* * *

Mr. Claude Fleming, Matamata, has just returned on the *Dominion Monarch* from South Africa where he spent six months with some members of his family. Amateur movies is Claude's hobby and an interesting collection of films taken by him during his wanderings was enjoyed by a party of friends celebrating his return.

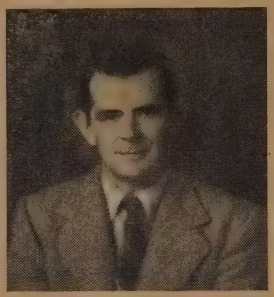
* * *

Certain goings on in Auckland recently, by two radio fellows, created a mystery. They left their hotel to keep a late appointment, and on arriving back found the hotel to be well and truly closed for the night. However, these two hardy "components" had long since learned the tricks to overcome the necessity of sleeping in the park. How be it, some well meaning person advised the manager of certain actions perceived, but let it be said to the credit of the said "components" that they looked in good shape, for on meeting up with the manager in night attire and presumably well-armed, were surprised to be commissioned with much haste to help catch two burglars. In all innocence, and with eager lust for the kill, both "components" joined in the search.

Just a case of burglar chasing burglar and no kill!

* * *

While in Auckland recently, Mr. Chas. Roser had the pleasure of meeting Mr. R. K. (Ron) Waddell of the Seddon Technical College staff. Ron Waddell's letter to the Editor appearing in our September issue has been given enthusiastic attention by Auckland newspapers, and created a great amount of interest throughout the radio trade generally.



Ron's job is electronics training at the Seddon College, and his "big" is the training of servicemen for television. Reference has already been made in our pages to what is being achieved in Auckland as a result of his efforts—and he says this is only the start!

Born in Christchurch about 40 years ago, Ron took his science degree at Auckland University, and joined the staff of the Seddon College in 1940—but soon obtained leave of absence to become a naval officer instructor. Among the various ships in which he served were the New Zealand *Achilles* and *Leander*—in fact, he was in the latter ship when she was (as he puts it) "punctured by a torpedo" in the Battle of the Kula Gulf. He says that the Navy "broadened his mind" (though what he means we cannot imagine) and certainly gave him a keen interest in radar. Interest in television followed naturally.

We think that Ron has really "started something" with electronics and television training in Auckland, and wish him every success in a job that must benefit everyone in the radio trade.

* * *

It is interesting to note that a second New Zealand radio manufacturing concern will, in the near future, be celebrating their jubilee. We refer to Messrs. Collier and Beale, Ltd., Wellington, who this year have completed 25 years of successful operations.

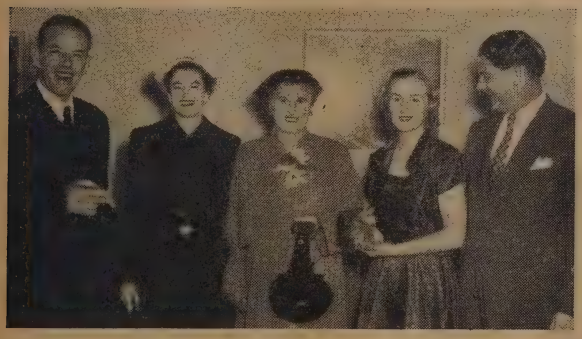
L. G. HAWKINS VISITS N.Z.

Mr. L. G. Hawkins

A recent visitor to New Zealand from England was Mr. L. G. Hawkins, founder of the Hawkins pressure cooker business. As he is also a director of Pye Limited, Cambridge, his was a double purpose visit and at several functions and meetings Mr. Hawkins gave some interesting sidelights on the productions of goods in England under the present difficult conditions.

At a cocktail party held at Wellington, when members of the hardware and the radio and electrical trades

were his guests, Mr. Hawkins, told of the ingenuity of his company in improvising substitutes for metals in short supply owing to war stock-piling in Britain. In spite of all this the Hawkins organizations were able to keep up production, of which New Zealand had a very good quota while the Home market suffered because licence there to manufacture was subject to the condition that all but 10 per cent. of the production



As guests of Mr. and Mrs. G. A. Wooller, Mr. and Mrs. Hawkins were entertained at Auckland. Above: A section of the gathering: Below: Mr. L. G. Hawkins, Mrs. Wooller, Mrs. Hawkins, Miss Shirley Hawkins, Mr. G. A. Wooller.

must be exported. After wastage and spoils it left very little out of the 10 per cent. for the English housewife. He was amazed to see the potential market still existing in New Zealand, but he realized that the New Zealander was appreciative of good quality goods.

As a director of Pye, Limited, Cambridge, he felt he should say something about local manufacturing and while he appreciated that New Zealand was extending in this respect, he hoped it would not reach a point when it would seriously affect Great Britain who was now more than ever before, dependent for her very life on increasing her exports.

Mr. Hawkins said that responsible heads at Home were not unmindful of the low price that New Zealand

(Concluded on Page 48.)

Latest Record Releases

INTRODUCTORY NOTE

The Editors take great pleasure in announcing that they have arranged, through the courtesy of Messrs. H.M.V. (N.Z.) Ltd., to publish every month a list of the latest gramophone records to be released in this country. The records mentioned will all have been distributed in the retail shops by the time *Radio and Electronics* is published every month, but since releases are made more frequently than once a month, it will not always happen that additional supplementary lists have not been issued by Messrs. H.M.V. (N.Z.) Ltd. after this journal has gone to press. In all cases, however, this feature will include records released right up to the time of our going to press. The firstly monthly list of releases follows, and we feel sure that the large numbers of our readers who are interested in the reproduction of recorded music will find them most helpful and interesting.

ORCHESTRAL

Peer Gynt Suite No. 2 (Grieg), City of Birmingham Orchestra, conducted by George Weldon. Col. DX1531/2.

Overture to "Samson" (Handel) Philharmonic Orchestra, conducted by George Weldon. Col. DX1731.

Symphony No. 5, Op. 50 (Nielsen) and Maskarade—Prelude to Act II (Nielsen) Danish State Broadcasting Symphony Orchestra, conducted by Erik Tuxen. Dec. Z7022/6.

Music of the Spheres, Waltz (Josef Strauss) Vienna Philharmonic Orchestra, conducted by Karl Boehm. H.M.V. C.4070.

CONCERTOS

Gioconda de Vito (violin) with Royal Philharmonic Orchestra, conducted by Sir Thomas Beecham, Concerto in G Major, K.216 (Mozart). H.M.V. DB.9570/2.

Concerto in G minor (Bach) George Malcolm, harpsichord, with London Chamber Orch. conducted by Anthony Bernard. H.M.V. C.3963/4.

Concerto Grosso, Op. 3 No. 2 (Geminiani). Orchestra D'Archi (with two violins, cembalo, viola, and cello), conducted by Carlo Zecchi. Parl. R.30011/2.

INSTRUMENTAL

Chopin waltzes No. 3 in A minor, No. 13 in D flat, No. 4 in F, played by Dinu Lipatti, pianist. Col. LX1342.

Sonata in E minor, No. 34 (Haydn) Monique de la Bruchollerie, pianist, H.M.V. DB.21038.

Quartet in B flat, Op. 67 (Brahms) Busch Quartet, Col. LX. 8705/8 and LXS.8709.

OPERATIC AND LIGHT OPERATIC

March and Entry of the Guests, from Tannhauser (Wagner), Vienna Philharmonic Orchestra and Vienna State Opera Chorus, conducted by Herbert von Karajan. Col. LX.1347.

Di Quelia Pira from Il Trovatore (Verdi) and No! Pazzo Son! from Manon Lescaut (Puccini) Beniamino Gigli, with orchestra, H.M.V. DA.5398.

The Mikado. Complete new recording by the D'Oyley Carte Opera Company, Decca. AK.2388/98 (Set D.241).

VOCAL

Da Braussen in Der Wachau (Weill) and In Grinning Gibt's a Himmel Strassen (Werner) Erich Kunz, baritone. Col. LB.100.

Der Engel and Stehe Still (Wagner) Kirsten Flagstad, soprano. Piano accompaniment by Gerald Moore. H.M.V. DB.6841.

No. Querio Tus Avellanas and Jota (Guridi) Victorial de los Angeles, soprano. Piano accompaniment by Gerald Moore. H.M.V. DA.1961.

DANCE ORCHESTRAS, LIGHT VOCAL, ETC.

Old-time Dance Series—No. 105—County Cotillion Waltzland, Harry Davidson and his Orchestra. Col. DX.1722.

Slaughter on Tenth Avenue (Rodgers) Les Brown and his Band of Renown. Col. DB.2823.

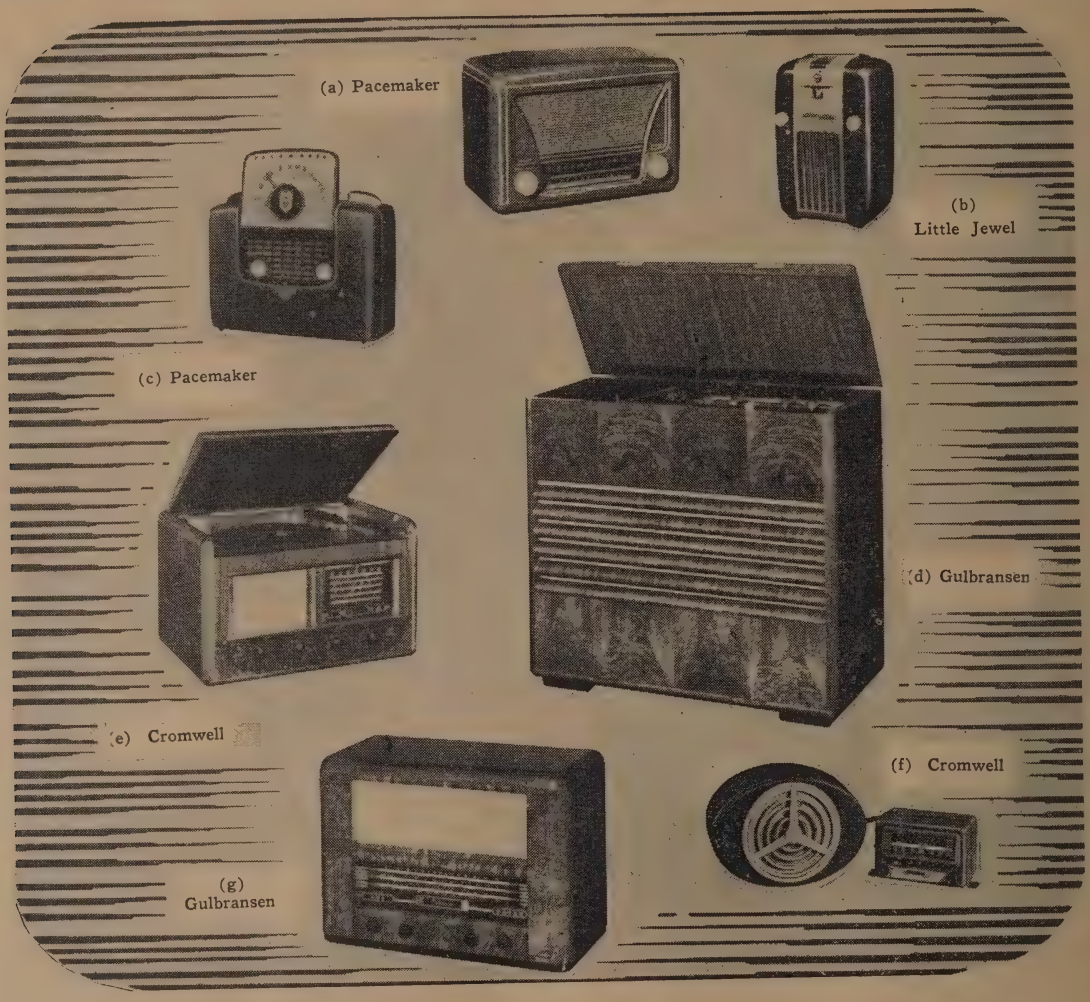
Fascination, Gypsy Waltz, and Pizzicato from Coppelia (Delibes) Tom Jenkins and his Palm Court Orchestra. H.M.V. B.9932.

Black Bottom Stomp, and Grandpa's Spells. Jelly Roll Morton and his Red Hot Peppers. H.M.V. B.10048.

Freddy Gardner, Saxophone, with Peter Yorke's Orchestra. I'm in the Mood for Love, and I Only Have Eyes for You. H.M.V. DB.2411. Roses of Picardy, and These Foolish Things. H.M.V. DB.2548. Body and Soul, and Valse Vanite, H.M.V. DB.2665.

1926-1951

NEW ZEALAND FIRM'S TWENTY-FIVE YEARS OF PROGRESS



KEY TO ILLUSTRATIONS

(a) All-plastic five-valve B/C and D/W receiver.
(b) B/C receiver.
(c) All-plastic electric/battery portable radio.
(d) 11-valve all-wave console radio-gramophone.
(e) Seven-valve dual-wave table radio-gramophone.
(f) Auto radio receiver.
(g) Ten-valve all-wave high-fidelity mantel radio.

The Broadcast Receiving Sets illustrated above, typical of a wide range of well-known models, give evidence of the Company's maturity in the Radio Manufacturing field.

These accomplishments are largely due to the generous support of many trade friends and to the unexampled loyalty and skill of our employees.

In fitting celebration of our Silver Jubilee, we pay tribute to all those who have contributed to our progress and the development of Radio in New Zealand.
December, 1951.

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WELLINGTON, NEW ZEALAND.

★ RADIO MANUFACTURING IN NEW ZEALAND

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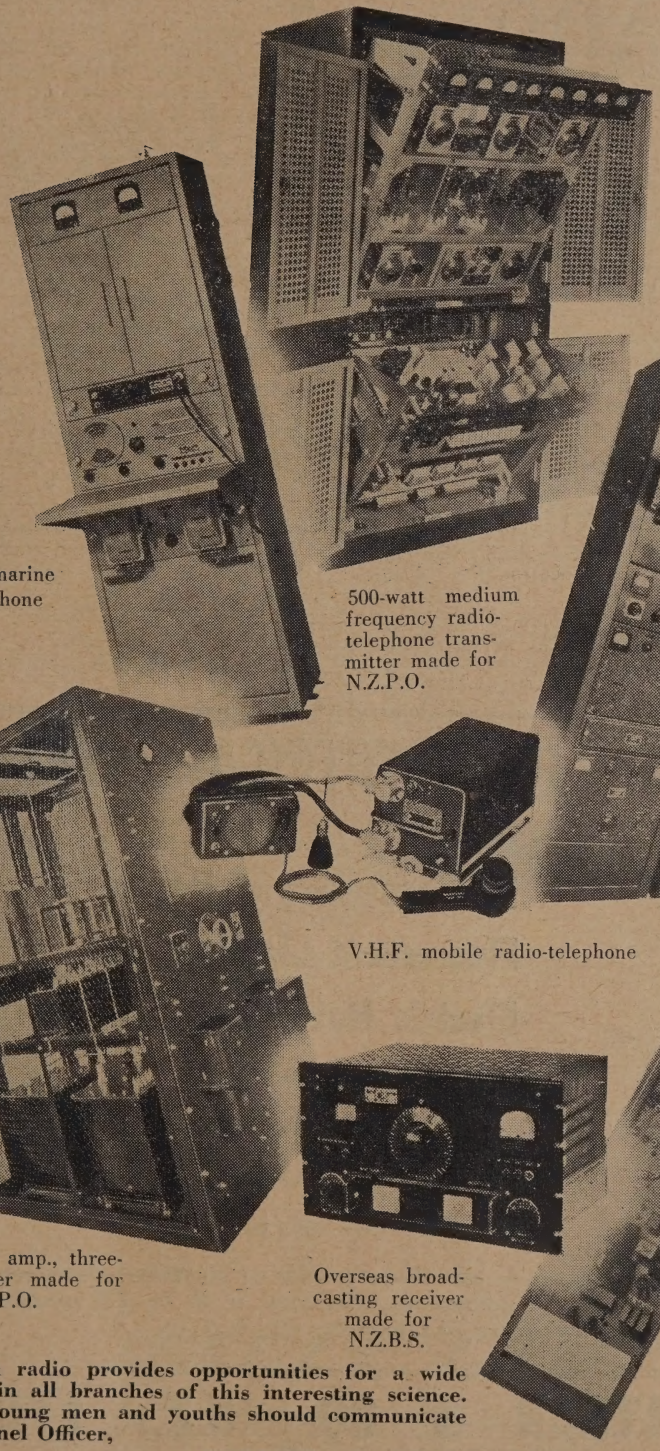
Illustrations show the wide scope of manufacture of commercial radio apparatus and typify the high order of engineering skill evident in the Company's products, including over 100,000 broadcast receiving sets of exclusive New Zealand designs made and distributed over the past twenty-five years.



Radio-telephone terminal equipment with automatic coding speech secrecy gear made for U.S. Forces.

4-channel marine radio-telephone

500-watt medium frequency radio-telephone transmitter made for N.Z.P.O.

V.H.F. mobile radio-telephone

6,000 volt, 1 amp., three-phase rectifier made for N.Z.P.O.

Overseas broadcasting receiver made for N.Z.B.S.

V.H.F. radio-telephone apparatus made to design and prototype of N.Z.P.O

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R.F. Power Measurements

(Continued from page 13.)

water-filled section. The impedance of the bead section must satisfy the familiar condition for quarter-wave transformers:

$$Z_m = \sqrt{Z_1 Z_2} \quad (2)$$

Where:

Z_m is the impedance of the matching section.
Z_1 is the impedance of the air-filled line.
Z_2 is the impedance of the water-filled section.

This is achieved by selecting a material for the bead which has a dielectric constant of about 9, which is the geometric mean between that of air (1) and water (about 81).

The load depicted in Fig. 6b is effective over a greater bandwidth than the quarter-wave transformer type discussed above. This is because impedance matching is done gradually by tapering the water column rather than introducing it abruptly. The centre conductor of the load is gradually replaced by the water stream. The water is introduced through the stub support, which is the only frequency-sensitive element in the load.

Two types of water calorimeter loads which are used with waveguide transmission lines are shown in Fig. 7. The kind which employs a glass water tube diagonally across the guide is usually preferable because of less thermal lag.

Water loads are useful as power indicators over the range of several watts to several thousand watts. They are not generally applicable to lower power measurements.

Trade Winds

(Continued from page 15.)

received for her exports, and perhaps New Zealand could complain of the high price she had to pay for goods from Britain (laughter). It was, however, a matter all tied up with the huge programme of production for defence and rehabilitation of Great Britain. So, in respect to local manufacture, it might be asked why a Pye (N.Z.) Company was just founded in New Zealand. It was a matter of defence policy, continued Mr. Hawkins, just ass Pye, Cambridge, Ltd., had opened up in Canada and Australia, so in New Zealand, for the very special reason that as England is very vulnerable to attack it was desirable to spread her radio industries to fields less subject to damaging attack. Thus not only would we have supplies of essential radio equipment, but also trained personnel for radar could be more readily available.

Mr. Hawkins spoke of his pleasant trip through the North Island, and like others, said he had too little time to do the South Island. With Mrs. Hawkins and daughter Shirley, he found New Zealand tourist resorts past expectations, and ass for fishing, had caught at least five big ones, and these, according to the locals, were not so very big. Never in England had five in one day measured such length! His present stay in New Zealand had served to make him wish to be back again at an early date.

FOR SALE.—Radio and Electrical Business in Masterton. Option of two houses if required. Best offer. Must sell. Owner taking over sheep farm.—J. B. Berney, 267 Queen Street, Masterton.

WANTED—Small quantity of 959's ex War Assets. Please ring or write Bannister, Paraparaumu Airport.

LAMINATIONS IN ELECTRICAL STEEL

for—

Manufacturers of Radios
Fluorescent Lighting, and
Electric Motors and Generators

STANTRANIS	1	0.74 watts loss per lb.	at 10,000 gausses and 50 cycles in 0.020" material
STANTRANIS	B	1.02 watts loss per lb.	
MEDRIS	.....	1.30 watts loss per lb.	
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A wide range of standard types in the above grades of electrical sheet steel is produced, but owing to re-armament, delivery is 9 to 12 months, therefore order early.

Send your inquiries, stating types in which you are interested, to—

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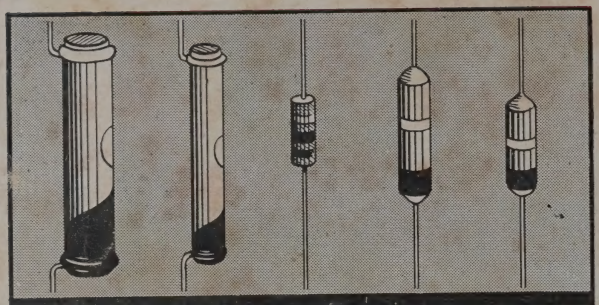
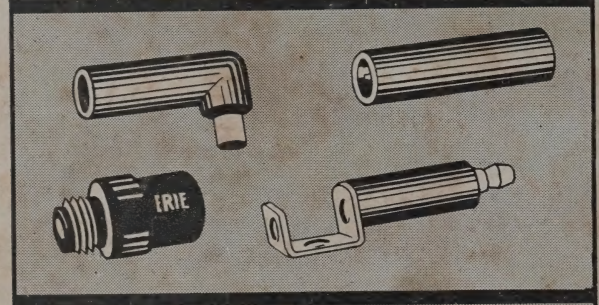
ER51/F32

ERIE *Electronic Component Products*



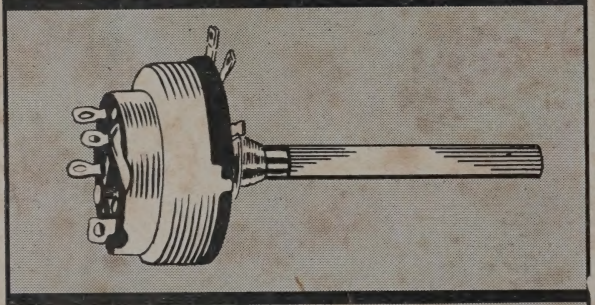
CARBON RESISTORS

Erie Resistors are the finest offering on the New Zealand market. Constant research has not only improved their electrical characteristics but has resulted in the development of new, *smaller* units and insulated types that meet the urgent demand for efficient performance in restricted space under severe operating conditions.



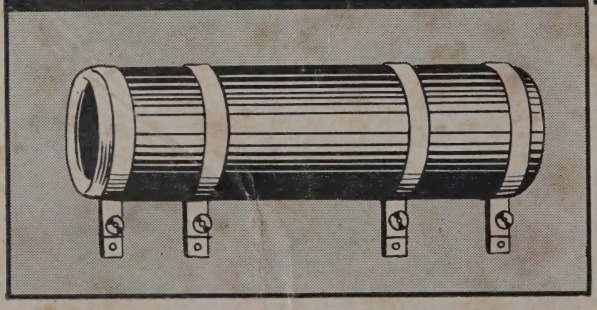
SUPPRESSORS

Erie Suppressor Resistors are designed for the suppression of high-tension interference caused by the ignition system of internal combustion engines without detracting from the performance of the engine. Available in four different types sufficiently diverse to fit any known make of car.



POTENTIOMETERS

Erie Potentiometers are of the carbon track type and embody a carbon-sprayed bakelite element with a maximum overall dissipation of one watt, and are available in values from 2,000 ohms to 2 megohms inclusive, either with or without switches, which are of the S.P. Single Throw and D.P. Double Throw types only.



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Erie Silicone-finish Wire-wound Resistors are wound on a high-grade ceramic former which will withstand considerable thermal shock without disintegration. Windings are spot-welded to flexible copper nickel or nickel chrome wires brought out in the form of pigtails tinned with hot solder or connected to nickel silver bands according to individual preference. Maximum rating is 100 watts, maximum size 63/16 in. x 11/8 dia., maximum resistance 50,000 ohms, and within these limits all resistors are made to individual requirements.

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